THE
PRACTICAL MAGAZINE

NEW SERIES.—NO. 4. VOL. 5, 1875.

MR. PULESTON, M.P., AND THE NATIONAL SAFE DEPOSIT COMPANY.

WHEN King John, of ignoble memory, ruled over this goodly realm of England, the necessity of strongholds was duly recognized. In that loose state of society, where the king appropriated what he dared from the barons, and the powerful barons took all they could seize from the weaker ones, every man who had anything worth keeping built his castle and defended himself as well as he could against robbers of high or low degree. Life was unsafe, and might made right.

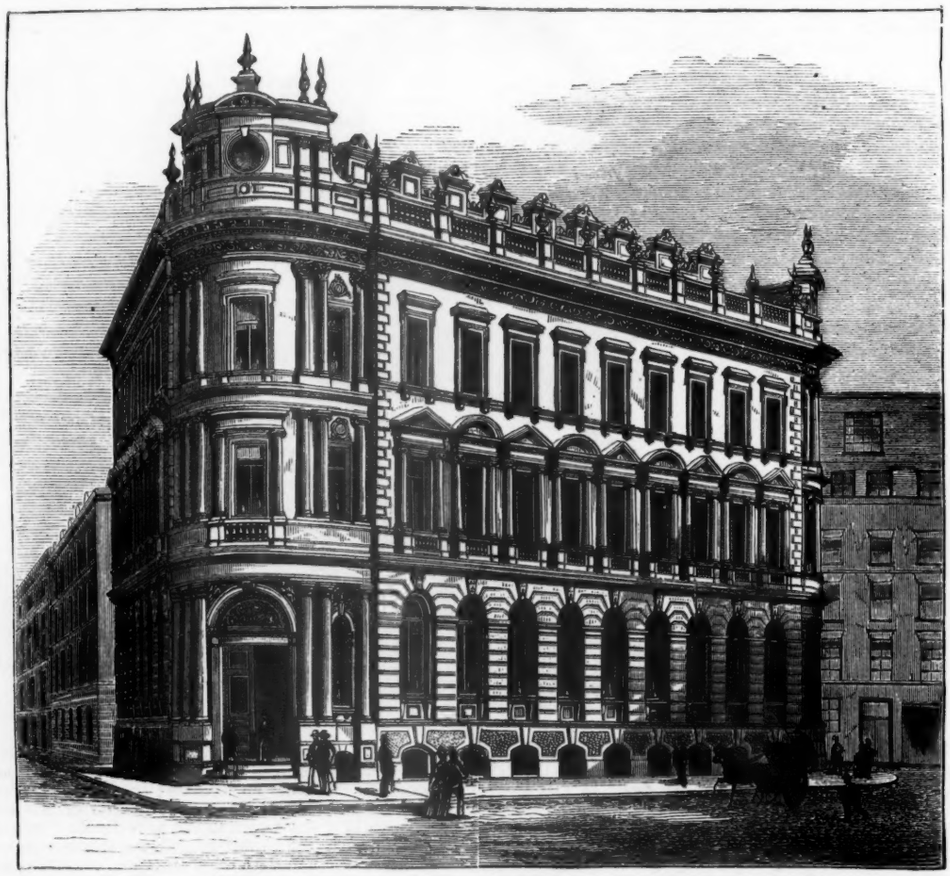
While there is now no such need of fortresses for the protection of life, a necessity still exists in this wayward world for the protection of property by substantial and material safeguards. Although wealth is secured to its possessor by law from the attacks of open, violent plunderers, in these latter days the enemies of society are more insidious. We have, moreover, invented numerous ways of conferring value upon mere paper, and multiplying wealth both portable and negotiable. The accomplished burglar will generally open the most intricate lock if time be allowed him, and fire will consume in a moment those pieces of paper or parchment called "securities," whether they be foreign bonds, railway mortgages, debentures, title-deeds, bills of exchange, or the crisp notes issued by "the old lady of Threadneedle Street."

The law protects the property of the subjects of Queen Victoria from rapine and violence; but now, as ever, if you choose to bury your gold in your garden, or to hide it under your pillow, the thief may discover and take your secret hoard, and elude the punishment which the law provides. You may trust your valuable securities to the protection afforded by a so-called fire-proof safe, and after some great conflagration find a handful of ashes remaining of your burnt-up treasure; or you may conceal your bonds and debentures in some secret drawer or box, and after the absence of a day return to find your dwelling burned to the ground, or ransacked by thieves and your property stolen.

Wealth in these modern days, therefore, often takes a perishable form, and may literally fly away like an eagle toward heaven. It may assume the form of coupon bonds, payable to bearer, and it is estimated that *thousands of millions sterling*, invested in these and other negotiable securities, are dealt in on the London Stock Exchange alone. These, if lost or stolen, and sold to a *bonâ-fide* purchaser before the loss or theft is detected, cannot be recovered from the holder. Some nervous owners, aware of the danger of losing such property, and the difficulty of recovering it when lost, separate the coupons from the bonds, and keep them in different hiding-places; but this method is open to objection, for it *secures* neither the bond nor the coupons. It merely separates the principal from the interest, and increases the chances of losing one or the other. It is amazing to notice the carelessness of many people whose entire wealth and fortune is invested in such securities, respecting the safety of their property. Some confide their treasures to their bankers; and millions, for which there are no guarantees of safety, are in the custody of London bankers. Everyone does not know that bankers are specially absolved from any responsibility in respect to such deposits. It is right that they should be; for they provide no adequate means of security for them.

There has just been completed in the heart of the City of London, a building beneath which it may safely be said is a small fortress, unlike anything to be found in the wide world. It is burglar-proof, fire-proof, bomb-proof. The building stands completely isolated from any other, and this isolation adds in no small degree to the security of the vaults beneath. The superstructure, which is not specially noticeable except as a very massive and pleasing specimen of architecture of the pure Italian order, is triangular in shape. It is three stories in height and faces Queen Victoria Street, where the roaring of the wheels is loudest, within a stone's throw of the Royal Exchange and the Bank of England. Its narrowest façade is on Charlotte Row, which separates it from the Mansion House, and the rear is bounded by Bucklersbury. These are the premises of the "National Safe Deposit Company, Limited," and it is probable that no better site could be found in London for the business objects of the company. The vaults, which have been sunk to a great depth, have been constructed to provide a place absolutely secure from thieves, burglars, fire, riot, and even earthquake. This has been a task not easy of accomplishment, and has entailed a great expenditure of money, time, and thought, for London, albeit the richest city of the world, is the home of the cleverest knaves, and no mere safe fitted up with locks, bolts, and hinges would baffle them.

Like the castles of olden times, this fortress has its moat. It is wholly surrounded by water, thus affording complete protection against fire. Mining operations here would be futile, for those who might attempt them would be deluged, drowned, before they had perforated more than the outer shell of this unique fortress. The walls are of an aggregate thickness of 6 ft., of the hardest bricks it is possible to make, and backed by a wall of concrete nearly two yards thick. Inside all is the



PREMISES OF THE NATIONAL SAFE DEPOSIT COMPANY, QUEEN VICTORIA STREET, E.C.

iron armour-plating, 5½ in. thick, constructed of the best undrillable iron. The core of the citadel is 69 ft. long, 31½ ft. wide, and 36 ft. high, and is built on arches, so that the whole of it, top, bottom, and sides, can be constantly examined by the armed watchmen who will patrol the premises night and day. The roof of the vault is also formed of bomb-proof semi-circular arches. This iron vault is divided into four floors, one above another, each with a floor area of 8692 ft., and like the fabled chamber of Danaë it can only be entered by the shower of gold —for which it is specially designed. To abstract that gold or its equivalents will be impossible except for the rightful owners, who will have every facility of access to their property.

Two floors, or one-half the space in the great vault, is devoted to the small safes, 10,752 in number; these are to be let to the public. Each small safe has its own peculiar lock, unlike every other one, and whenever a new renter takes possession of a safe it will be provided with a new lock. The safes vary in size from a few inches to 2 ft. square, and all of them have a uniform depth of 20 in. They will be let according to their size at rates varying from £2 10s. to £30 per annum. The lessees will find them easy of access during business hours, and private but necessarily diminutive rooms will provide every facility for undisturbed examination of securities, cutting off coupons, &c. Hydraulic lifts constantly in motion will convey customers from the upper to the lower floors of the great vault, and a spacious staircase is ready for those who cannot wait a few seconds to ride.

Rather more than one-fourth of the entire space of the great vault is reserved for the reception of plate-chests and boxes comparatively bulky, and the remaining space, or rather less than one-half that occupied by the private safes, will be set apart for valuables placed directly under the company's guarantee.

The doors, which are usually the points of weakness in a stronghold, have been made the centres of the greatest strength.

They are constructed without locks, hinges, or bolts of any kind; but as they weigh *four tons each*, and as it would require a Cyclops or two to stir them, when they are closed they are locked by their own immense weight. They are thirty-two in number, are a clear foot in thickness, of metal harder than spiegeleisen, and are the invention of John Whichcord, Esq., F.S.A., the able architect of the company, who, when he found that two years must elapse before doors such as were desired could be made with efficient locks, conceived the idea of dispensing altogether with anything so commonplace, and by the skilful adaptation of a simple power, has found a way to open and close these huge valves surely, quietly, as if by some mysterious agency, or as if he had called up some "spirit from the vasty deep." What the hundred-handed Briareus could not do is quickly accomplished by the aid of Poseidon, shall we say? But woe betide any living thing that comes in the way of these gigantic doors! Better to feel the embrace of a grizzly bear than the hug of one of these remorseless iron monsters. But there is not much danger of falling within their grasp, for a fan, describing the segment of a circle, with its radius at right angles to the door, sweeps away all obstructions. The doors are shut as if by a thousand bolts till the *open sesame* of the proper authority is heard, and the mysterious spirit or afrite at the beck and call of the company moves them then as if they were pieces of cardboard. To drill through these doors is practically impossible. They have been tested by one of the best drillers in London, who, after breaking, wearing out, and dulling eighty-six of the best drilling tools, gave up in despair, after fourteen hours' work, having penetrated the model less than a single inch.

We have not told all, but we have said enough to prove that this is a place of unusual strength. What other appliances the company have provided for the protection and defence of their premises we are not at liberty to say; but it is certain that a very terrible reception would await any attempt to force a passage.

The "National Safe Deposit Company, Limited," was formed to meet a great want of the public, which year by year is growing more imperative. It has a nominal capital of 50,000 shares of £10 each, of which the first instalment of £5 has been paid, and which stands to-day in the market at 1¼ per cent. premium. John Henry Puleston, Esq., M.P., of the firm of McCulloch and Co., bankers, Lombard Street, is chairman of the company, and he has given to the enterprise valuable experience, and its probable complete success will be largely due to the energy, tact, and capacity for managing a business that has no parallel in this country, shown by him and his colleagues in the board, who are well known as men of wealth and standing in the City, and hold other important positions of trust. Of the members of the board, George W. Barnett, Esq., is a partner in the old banking firm of Messrs. Barnetts, Hoares, Hanburys, and Lloyd; Lord William M. Hay is chairman of the Anglo-Mediterranean Telegraph Company; Lawford Acland, Esq., is chairman of the Ceylon Company; George Arbuthnot, Esq., director of the Union Bank, London; H. S. Coulson, Esq., director of the United Discount Corporation; and Hugh F. Sandeman, Esq., director of the Scottish Union Fire and Life Insurance Company. Mr. Graves, late Member of Parliament for Liverpool, after travelling through the United States and inspecting the Safe Deposit institutions of that country, joined the board of directors, but his death deprived the company of his valuable counsels and the results of his extensive experience and observation.

It will be noticed that the gentlemen who have the direction of this enterprise merit the entire confidence of the public, but nothing will be left to chance. Every vulnerable point will be doubly guarded, and checks and counterchecks upon the management will ensure the complete safety of the deposits even against internal conspiracy, if such a thing were possible.

Mr. Gray, the managing director, is a most thorough, careful man of business, formerly connected with the Oriental Bank Corporation; since the organization of the company he has devoted his whole time to it.

This enterprise is not a novelty. It has stood the test of experience in America, and from Maine to California there is not a large city which has not its Safe Deposit Company, and there is not a city among them all that could now dispense with the security thus afforded. It is found that they do not interfere with the banks, but render them immense assistance. This company hold the plans of similar buildings in America, and have improved upon them all, and provided a vault much stronger than any one of them. The fires of Chicago and Boston have taught very important lessons in the construction of fire-proof buildings, and this Company have not been slow to learn them.

Dr. William Pole, a well-known authority on iron construction, and General Gossett, for many years commanding the corps of Royal Engineers, at Woolwich, were consulted upon the plans of the works, which have been most efficiently carried out by the contracting engineers, Messrs. Eastons and Anderson, and the builders, Messrs. Peto Brothers. The basement of the building is lighted by eleven of Hyatt's patent pavement lights of the latest and most improved patterns. Nine of them are his celebrated "cluster lens," and two of them are "illuminating encaustic tiles," an article entirely new, these being the first put down.

The superstructure has been very substantially and carefully built, and reflects great credit not only on the architect but on all who have had any share in the work, and the directors have taken great pains that all should be done in the best possible manner, and without extravagance.

As Blücher stood upon the dome of St. Paul's, and looked out upon the misty metropolis, the story goes that he exclaimed, "What a fine city to sack!" If it were true in his day, how much more so now, when nearly four millions of souls, with their dwellings and their wealth, are crowded within its boundaries. Londoners have been accustomed to look on the chances of any such calamity as a general conflagration in the great city as sufficiently remote, but hardly a year has elapsed since the burning of the Pantechnicon, when, if the wind had been in another quarter, nothing could have saved Belgravia from destruction. There are warehouses in many parts of London, where combustibles and explosive materials of the most destructive nature are stored, which may take fire any day. Does anyone know how much petroleum there is in London? or gunpowder? or even nitro-glycerine? We have the Nitro-Glycerine Act, which attempts to regulate the manufacture and storage of this substance, but how many chlorate and fulminate compounds are in constant use in the arts and for mining and engineering purposes, from the dangers of which the public are insufficiently protected! It does seem evident that the National Safe Deposit Company have provided their strong box at the right moment, and although they have incurred great expense in constructing their vaults, they are enabled to offer the advantages of perfect security at a trifling cost to each customer.

Henceforth the holder of a safe in this institution can lock up his securities, visit the seaside, journey to the Continent, climb Mont Blanc or the Pyramids, sail up the Nile to the Second Cataract, or spend a year or two in the heart of Africa with Stanley, in confident assurance that when he returns he will find everything as he left it. He can make his will and deposit it with the company, and no reward of £500 will be needed to bring it to light. Trustees can ensure themselves against the anxiety that oppresses them. Duchesses, whose jewel-cases are now left to the custody and cupidity of their lady's maids, can hire a safe and breathe freely, having no fear that their diamonds will take a hasty journey to Amsterdam or St. Petersburg, never to return; and the large class of people whose only wealth consists of those convenient but negotiable and perishable coupon bonds, can deposit their all and sleep soundly, without dreams of midnight assassins, or, what would be worse, the dread reality, staring them in the face.

Mr. Puleston, the chairman of the National Safe Deposit Company, is a member of the firm of McCulloch and Co., of Lombard Street, and now sits as a Conservative in the House of Commons as member for Devonport. He was elected at the last general election, defeating Mr. Delaware Lewis, a leading Liberal member of the late Parliament. It may be mentioned that Mr. Lewis's father was born in America, and we believe named Delaware after the State of his birth. It is a somewhat curious coincidence that the son should be succeeded in Parliament by Mr. Puleston who, though an Englishman, lived long in America, and has still close connections with that country. While a resident on the other side of the Atlantic he formed intimate relations with the public men there, and we find his name associated with many incidents of the Civil War, and in sanitary matters he was especially active. Present as a spectator at the first engagement of the war, he was stunned by the concussion of a shell, but recovering immediately he was able to reach Washington and to communicate the first news of the opening of hostilities. Two or three days later he reported the first battle of Bull Run to some of the American journals, and afterwards several of the subsequent engagements. His report of the disastrous battle of Balls Bluff in the "New York Tribune," according to one of the historians of the period, produced "considerable excitement." During the later years of his residence in America he was in active business in New York, and about four years ago, in association with the Hon. Hugh McCulloch, formerly a member of the American cabinet, he came back to England to establish a banking-house in London. During his long residence in New York he took an active part with British residents in their national and charitable societies, and for several years was president of the St. David's

Society of that city. During Prince Arthur's visit to the States Mr. Puleston's name became familiar on this side by the part he took in the arrangements for the Prince's reception, and he was one of a committee appointed in behalf of British residents to prepare an address to His Royal Highness. As a business man, since his return to this country Mr. Puleston has been well known, and to his connection with the Safe Deposit Company we have already alluded. As a politician he was first known before the dissolution of the last Parliament by the fact that he was "wooed by two constituencies," the discussions which ensued between the Conservatives of his native county (Denbigh) and those of Devonport, who claimed him as a candidate, being humorously referred to at the time. His subsequent election, as might have been expected, was widely noticed by the American press, and this brief reference to one who has occupied in both countries some share of attention, will not be devoid of interest to many of our readers.

Mr. Puleston is a member of the select committee of the House of Commons on Loans to Foreign States, of which Mr. Lowe is chairman.

W. D. S.

Chemistry applied to the Arts, Manufactures, &c.

ABSTRACTS FROM FOREIGN PERIODICALS, TRANSACTIONS OF SOCIETIES, ETC.

§ 1. *Acids, Alkalies, and Salts.*

BOILING Sulphuric Acid.—M. BOBIERRE uses a gas furnace, the burner of which has small holes—a furnace with Bunsen burners is unsuitable,—and a retort of about 550 cubic centim. capacity. In this he places not less than 12 grammes of platina in thin strips, 320 cubic centim. of sulphuric acid are then put in, and heat is given gradually. Ebullition proceeds as tranquilly as can be desired; and if the arrangements admit of the introduction of a thermometer, the height of the mercurial column will be found singularly stable, which is not the case wherever the cumulative tension of the vapour within the retort constitutes an element of danger. *Comptes Rendus, lxxx.* 8, 1875.

Concentrated Aluminous Selenite, for Paper-makers' Use.—BOURDILLAT of Paris patents this artificial mineral, containing ½ to 1 per cent. of water, as a substitute in paper manufacture for china-clay, gypsum, and similar substances, which contain 18 to 25 per cent. It is prepared by subjecting fine crystallized gypsum to a temperature of 400 C. for 15 hours, carefully avoiding contact with smoke or flame. Fine white clay is subjected to heat in like manner, until all the water contained in it is expelled. One-third or one-fourth part by weight of the clay is then mixed with the gypsum in a specially designed apparatus. If sulphate of alumina is employed instead of clay, the fragments of gypsum are placed in an oven, in a concentrated bath of the sulphate, and pounded, after eight hours' firing. Amongst other advantages claimed for this preparation, it is said to go much farther than the mineral substances ordinarily used, to interfere in no wise with the sizing, and greatly to improve the gloss of the paper. *Bull. de la Soc. Chim. de Paris, xxiii.* 4, 1875.

Acids in Lubricating Oils.—As a ready method of testing lubricating oils for free acids, from which none are entirely exempt, M. OCTAVE ALLAIRE recommends the agitation of the oil in a saturated solution of crystallized carbonate of soda. The formation of a more or less abundant deposit indicates the presence, in greater or less proportion, of free acids, which are saponified by the soda.

The ordinary method of purifying fatty substances by beating them up with 1 or 2 per cent. of sulphuric acid, and filtering afterwards, produces a clear and limpid oil, but does not eliminate the acid principles; on the contrary, it increases them by the decomposition of a portion of the fatty salts.

M. Allaire asserts that the "huiles neutres raffinées" prepared by his new patent process are entirely free from acids, and give no precipitate whatever with carbonate of soda. *Technologiste, January*, 1875.

In a subsequent paper, in the *Revue Industrielle*, M. ALLAIRE explains the test process more fully. He says:—

To ascertain whether an oil is pure, it is merely necessary to take a lump of crystallized carbonate of soda, the size of a nut, to dissolve it in an equal volume of water, and to shake it up in a flask with some of the oil to be tested.

If on settling, after four or five turns of the flask, a voluminous solid precipitate is formed, the oil is impure, and should be rejected altogether.

In the same way, any oil that forms a coating of verdigris when in contact with the metal of a lamp, should be rejected as impure. *Revue Industrielle, 10th March*, 1875.

Salicylic Acid—Its Industrial and Medicinal Uses.—The subjoined particulars are furnished on the authority of a Chemical Manufacturing Company at Berlin:—

Salicylic acid is a pale yellowish powder formed of small crystals or fine needle-shaped particles. It precipitates in cold water, dissolves readily in hot water, alcohol, or ether, and fuses at 159° C. Under a slow heat it will sublime without decomposition. Heated quickly it resolves into carbolic acid and carbonic acid.

The researches of Professors Kolbe, Knop, Neugebauer, Thiersch, and others prove that salicylic acid is a perfectly efficacious substitute for carbolic acid, over which it possesses two advantages—a sweetish taste, and the absence of disagreeable smell. It is excellently adapted for preserving eggs, fresh meat, jams, beverages, medicinal essences, drugs, dye-extracts, &c. Professor Neugebauer's experiments show that 100 grammes of salicylic acid sufficed to prevent fermentation in 1,000 litres of must. He recommends its use in wine making, and in the treatment of the various affections of fermentative origin to which wines are subject.

According to Professor Kolbe, 5 grammes of salicylic acid effectively arrested the fermentation produced by the mixture of 5 grammes of barm with 120 grammes of sugar in a litre of water. He recommends its use in the manufacture of effervescing wines, export beers, &c. Fresh water on shipboard may be kept sweet by a mixture of the acid in a proportion not exceeding 1 part of acid in 20,000 of water. Or the water may be filtered, as required for use, through cotton-wool dipped in a solution of the acid. Meat may be kept fresh for weeks by rubbing it over with the acid, the latter being washed off when the meat is required for use. New milk containing ·04 per cent. of the acid, when left uncovered for thirty-six hours, was found in better condition than an equal quantity of the same milk without any admixture, which stood beside it. The professor's researches show that this antiseptic action is due to the free not to its acid, neutral salts.

Salicylic acid may be used as tooth-powder, or, mixed with warm water, as a mouth-wash. Sprinkled over the feet it is an effectual remedy for offensive odours arising from the perspiration. Applied as a powder with talc, soap, and starch, it renders the feet white and firm, and is a good antidote to sore feet, well adapted for the use of travellers and soldiers on the march. Mixed with powdered starch it may be advantageously applied to sores and cutaneous eruptions. A mixture of 1 part of salicylic acid, 3 parts phosphate of soda, and 50 of water forms a good wash for promoting the granulation of wounds. In operations involving much loss of blood, Professor Thiersch employs a solution of 1 part of the acid in 300 of water, to sprinkle the injured surfaces and to steep the bandages.

Dr. Fehling states that at Leipsic, salicylic acid is now universally employed as a substitute for carbolic acid in maternity practice. In disinfecting the hands, clothes, &c., in cases of puerperal disorders, it is used either mixed with water in the proportions 1 to 300 or 1 to 900, or as a powder mixed with amyl in the proportion 1 to 5.

Salicylic acid is soluble also in fatty oils, and may, therefore, replace carbolic acid in the preparation of Lister's bandages. Its internal use in cases of diphtheria, scarlatina, measles, small-pox, syphilis, cholera, &c., has yet to form the subject of experiment. Professor Kolbe finds that daily doses of 1·0 to 1·25 grammes of salicylic acid may be taken without affecting the digestive functions or the general health. The internal use of salicylic acid in a crude state is not to be recommended on account of its irritating effect on the mouth and throat; but Professor Wunderlich administers it in an emulsion composed as under: 1 gramme salicylic acid, 20 grammes ol. amyg. dulc., 10 grammes gummi arab.; mix, and add 25 grammes syrup amyg. with 45 grammes aq. flor. aurantii. *Industrie-Blätt. 11th Feb.* 1875.

§ 2. *Metallurgy.*

Analysis of Metals by Electrolysis.—ÆSCHGER and MESDACH employ this method for determining the proportion of copper and certain other metals in nitric solutions. When copper is present in large proportion, the operation requires 12 to 18 hours, and gives very exact results.

The batteries require special arrangement. They contain sulphate of magnesia, and a reserve of sulphate of copper. The electrodes are of peculiar shape; the negative, a truncated platina cone, open at the ends, with longitudinal slits; the posi-

tive, a platinum spiral within a similar cone. They are placed in a glass vessel containing the metallic solution. With substances rich in copper the following method is followed :—

Two grammes are dissolved in a porcelain capsule, with 40 cubic centimetres of aqua regia or nitric acid, to which are added 4 cubic centimetres of sulphuric acid, diluted with an equal volume of water. The water, acids, and sulphur are eliminated by evaporation and sublimation. Water is added so as to have 200 cubic centimetres of solution after filtering, to which is added 20 cubic centimetres of nitric acid. The cone and spiral, after weighing the former, are placed in the solution and exposed to the electric current for 18 hours. The copper becomes thus deposited on the cone. When the reduction is complete, the cone is weighed and dried, the difference in weight giving the amount of copper present.

Arsenic and selenium separate afterwards, and not unfrequently blacken the surface of the deposit. This must be avoided by stopping the electric current in time.

Lead, if present in small quantity, is deposited as a peroxide on the platinum spiral of the positive pole.

To separate the nickel and cobalt, the copper is precipitated as above. Hydrochloric acid is added to the solution, and the nitric acid got rid of by evaporation. It is then diluted with ammonia water and filtered, to separate the iron precipitate. This solution is submitted to the electric current, as in the preceding case, and the nickel and cobalt are deposited on the platinum cone. The increase of weight of the latter gives the weight of the nickel and cobalt together. To determine the weight of each, the deposit on the cone is dissolved with hydrochloric acid, and precipitated with nitrite of potassium. This precipitate is dissolved in nitric acid, and diluted with water. A fresh process of electrolysis deposits the cobalt alone. The difference gives the weight of nickel.

Herpin uses a platinum capsule containing the solution to be analyzed, in place of the cone at the negative pole, with very good results. *Bulletin de la Soc. Chim. de Paris, 20th Feb.* 1875.

Japanese Alloys.—M. KALISCHER gives the following analysis of certain Japanese alloys :—

	No. 1.	No. 2.
Gold	4·16	0·12
Silver	0·08	48·93
Copper	95·77	51·10

No. 1 is a light red, with a brilliant blue patina ; No. 2, a silver grey, with a yellow cast.

	No. 3.	No. 4.
Tin	4·38	4·36
Lead	11·88	12·29
Copper	76·60	76·53
Zinc	6·53	6·58
Iron	0·47	0·33

Nos. 3 and 4 are the colour of brass. They differ from our bronze in the large quantity of lead, and still larger proportion of zinc, contained in them.

In 1866, R. Pumpelly gave an analysis of certain Japanese alloys resembling the above. Under the name *shakdo* he describes an alloy of copper and gold (1 to 10 per cent. of gold), covered, like No. 1, with a bluish-black patina produced by immersion in boiling copper sulphate, alum, and verdigris. *Ginschi-bu-ichi* is described as an alloy of copper and silver (30 to 50 per cent. of silver). The grey patina so much esteemed by the Japanese is produced by steeping in the same solution. *Bulletin de la Soc. Chim. de Paris, xxiii.* 4, 1875, *from Berichte d. Deutsch. Chem. Gesellschaft, No.* 13, 1874.

Nickel Plating Iron.—BÖTTGER states that nickel is preferable to any other metal whatever for plating iron. Gold in a thin coat is very porous ; nickel, on the contrary, forms a ductile and impermeable envelope. *Revue Indust.* 17*th Feb.* 1875.

Determination of Copper in Bronze.—RIVOT'S method consists in reducing the copper dissolved in hydrochloric acid with sulphurous acid. It is tedious, and requires special apparatus. M. Ferent has long employed a modification of the same for copper alloys of all kinds, with complete success. An analysis, which under ordinary conditions would take two or three days, in this way may be effected in a few hours.

Any acid may be used. The cuprous liquor is concentrated, and sulphuric acid added to it in large excess. The volatile acids are eliminated by heat, evaporation being arrested as soon as sulphuric acid fumes made their appearance. The solution is cooled, diluted with water, filtered, and boiled. Soda sulphite is then added by small quantities, until the reduction is complete, which is indicated by a dirty green colour, and a certain turbidity in the solution.

The copper is then precipitated with ammonium sulphocyanide, and the precipitate collected, washed on a filter, and dried at 100° C. The weight of the precipitate multiplied by 52·30 gives the weight of copper.

If silver is present, it must be precipitated with a few drops of hydrochloric acid, and the solution filtered, before reduction with soda sulphite. *Revue Indust.* 24*th Feb.* 1874.

Engraving on Iron and Steel.—As the result of very many experiments, Professor KICK recommends the following solution for engraving iron and steel, to show the grain, &c. :—Equal parts of hydrochloric acid and water, with a trace of antimonial chloride. *Moniteur Indust. Belge*, 20*th Feb.* 1875.

Wrought Iron and Steel Manufactures of Sweden.—Official returns show that in the year 1873, there were in Sweden 237 manufactories of wrought iron and steel, the aggregate annual production of which amounted to 1,292,677 centners. The quantities imported in this and the preceding year were as follows :—

	1872. Centners.	1873. Centners.
Bessemer steel.	292,658·39	368,831·93
Other steel	80,433·63	30,767·38
Iron plates	159,100·16	186,083·35
Iron tires	31,553·71	68,820·86
Nails	188,031·79	181,304·73
Iron wire		23,900·00
Iron tools	52,288·43	38,327·40
Other descriptions of manufactured articles	345,663·84	394,641·38
Total	1,149,729·95	1,292,677·03

The manufacture of Bessemer steel during the year 1873 was distributed as below :—

	Centners.
Sandviken (Gefleborg)	109,253·00
Forsbacka (Gefleborg)	64,448·34
Vestanfors (Vestmanland)	57,677·50
Abackshyttan (Kopparberg)	47,147·70
Iggesund (Geflefora)	23,631·00
Svartnas (Kopparberg)	22,144·70
Langshyttan (Kopparberg)	14,455·90
Lenna (Stockholm)	10,943·90
Ulfshyttan (Kopparberg)	7,643·78
Bäcka (Kopparberg)	6,994·33
Frederickhausmer (Kopparberg)	2,728·45
Siljanfors (Kopparberg)	2,341·89
Carlsdal (Orebro)	381·34
Total	368,831·93

The exports of wrought iron and steel in 1873 were 321,155 centners, about 31,182 centners less than those of 1872, and 5,615 centners in excess of the exports of 1871. *Teknisk Tidskrift (Stockholm), Jan.* 1875.

Imitation Gold.—An alloy having a very fine and malleable grain, susceptible to a high polish and impervious to rust, and, while closely resembling gold, may advantageously replace that metal in a variety of cases), is made of 100 parts pure copper, 17 parts tin, 6 parts magnesia, 3·6 parts sal ammoniac, 1·8 parts quicklime, and 9 parts bitartrate of potassa. The copper is melted first, and the magnesia, ammonia, lime, and tartrate are successively added in small quantities. The tin in small pieces is then placed in the crucible, and the whole brought to fusion for 35 minutes, after which the alloy is allowed to cool.

Copper Welding.—The following recently patented recipe is the invention of Mr. E. RENAUD, of Washington, U.S.A. The ends of the copper to be welded are hammered out to form the lap. The pieces are then heated, dipped in powdered borax to clean the surfaces, and heated a second time. After the second heat the pieces are dipped in powdered cryolite (or any other anhydrous fluoride or similar salt, which, when heated, will form a liquid flux), and then hammered together on the anvil.

§ 3. *Dyeing, Calico-Printing, Bleaching, Tanning, Pigments, and allied subjects.*

Succotraloine.—DE SOMMANUGA and EGGER have obtained from Succotrine aloes a glycoside, differing from aloine and nataloine, to which they give the name "Succotraloine." Its composition is C^{15} H^{16} O^{7}. It melts at 116° to 120° C

Treated with chromic acid it gives a product resembling purpurine. *Bull. de la Soc. Chim. de Paris, 5th Feb.* 1875, *from Wiener Anzeiger*, 1874.

New Methods of Bleaching.—M. BRACKEBUSCH describes certain improved methods of bleaching, not yet sanctioned by practice.

1. The first is a method quite at variance with ordinary notions of bleaching linen and cotton goods. It consists in treating the fabrics with oxide of zinc dissolved in a ley of potash or soda. The oxide of zinc merely masks the natural colour of the fibres. It may perhaps form a colourless compound with their colouring matter. The use of the alkaline ley is likely to be injurious to the fabric.

2. Another, recently proposed, bleaches the silk or wool by an hour's immersion in a bath composed of 1 part sea-salt, 1 part oxalic acid, and 50 parts water. The effect of the oxalic acid is not yet clearly explained.

3. A third process, which deserves more attention, is that of TESSIÉ DU MOTAY. Equal parts of permanganate of soda and sulphite of magnesia are dissolved in warm water. The fabrics are steeped in a bath of the solution until they acquire a brown colour, they are then passed through a bath containing 4 per cent. of sulphuric acid, and rinsed until the brown deposit has disappeared. In the first part of the process the action of the permanganate is reduced by the deposition of an oxide of manganese; in the second, the oxide is dissolved with the acid, the dissolution liberating the oxygen in the acid, which contributes naturally to the bleaching effect. If the latter is incomplete, immersion in a sulphur bath follows.

4. Last to be noticed is RAMSAY'S method. In this the bleaching is effected by watering with a mixture of equal parts of chloride of lime and magnesium sulphate. A hypochlorite of magnesia is thus formed, which acts like that of lime, but has much less alkalinity. This process may be highly recommended. *Muster-Zeitung, xxiii.* 1874.

Purple from Cyanogen.—M. BONG precipitates, with dilute acid, the colour produced by the addition of cyanide of potassium to an acid solution of one of the salts of copper. The precipitate is re-dissolved with boiling carbonate of ammonia, the solution again precipitated with acid, and the new precipitate treated with sulphuretted hydrogen. A purple colouring-matter is thus obtained at very small cost, which in combination with metallic mordants displays considerable tinctorial powers, offering a variety of brilliant shades and remarkable powers of resistance to chemical agents and the influence of light. *Comptes Rendus, 1st March*, 1875. *Bulletin de la Soc. Chim. de Paris, 5th March*, 1875.

Removing Grease Spots from Clothing.—The undermentioned Dutch journal points out a mistake which very frequently is made in removing grease spots with benzine or spirits of turpentine—the solvent is applied with a sponge or piece of rag. This tends inevitably to spread the grease. The stained portions of the garments should be laid flat between two sheets of soft blotting-paper, and the upper sheet well soaked with benzine. In this way, if sufficient time be given, the whole of the fatty matter becomes not only dissolved but absorbed by the paper. *Isis* (*Haarlem*), *ii.* 1875.

§ 4. *Food and Sanitary Matters.*

Pulverization of Fertilizers.—M. MENIER points out the advantages of applying all fertilizing substances to the soil in a state of powder. This conclusion, deduced from his extensive experience as a manufacturing chemist, he has confirmed by experiment. He is satisfied that a preliminary reduction of fertilizing matters of all kinds to an impalpable powder—which might often be effected on the land, by wind or water power, or by the farm cattle in their spare time—would render it possible, without detriment to results, to dispense with fully one-half, and in some cases as much as three-fourths, of the quantities of manure now considered necessary. *Comptes Rendus, lxxxi.* 5, 1875.

Employment of Borax as an Antiseptic.—M. SCHNETZLER finds that borax possesses very remarkable antiseptic properties, which are likely to admit of useful practical application. Meat placed in a concentrated solution of borax has been kept for eighteen months, the solution having been renewed three times during that period, and is still perfectly sound. It has, however, acquired a peculiar smell, which, in a culinary point of view, would be objectionable. It is suggested that concentrated solutions of borax would be a cheap and efficient substitute for spirits in anatomical preparations, and might prove beneficial in the treatment of unhealthy wounds, &c. *Comptes Rendus, lxxx.* 8, 1875.

Dangers of Petroleum as an Insecticide.—German agricultural papers report several cases of fatal results to domestic animals, occasioned by the use of petroleum for destroying lice.

Ventilation of Theatres.—Dr. HÜBNER gives the following results of experiments made at the Théâtre Marie, at St. Petersburg, on the night of a performance in December last:—

In a box on the second tier facing the stage, the temperature was found to increase perceptibly every quarter of an hour, although the ingress and egress of the occupants tended to cool the air by opening a communication with the corridors. When the curtain rose, the temperature in the box was 18° C.; at the conclusion of the first act it was 24° C., at the beginning of the second, 25° C.

The humidity of the air increased more slowly. In the course of two hours it had risen to 30 per cent.; at the end of the fourth act it largely exceeded that of the outside air.

Hygrometric observations in the pit showed that the air there, at the commencement of the performance, contained 60 per cent. of watery vapour, that of an ordinary healthy dwelling; at the conclusion, it contained 85 per cent., the proportion in an injuriously unwholesome room.

The carbonic acid in the air, at the termination of the second act, amounted to 1·9 per 1,000 cubic metres, or six times the proportion in an ordinary respirable air; at the close of the evening's performance it was 4·3 per 1,000 cubic metres, a proportion amply sufficient to produce toxical effects on the lungs of persons accustomed to inhale a purer air. *Les Mondes, 25th Feb.* 1875, *from Journal de St.-Pétersbourg.*

Bread Mixed with Sea-water.—M. LILE strongly recommends the use of bread mixed with sea-water in cases of disease arising from poverty of blood, for convalescents recovering from acute diseases, and for healthy persons of delicate constitutions. It must be mixed with genuine sea-water, not the sea-salt of commerce in water. *Bulletin de la Thérapeutique, 15th February*, 1875.

Keeping Milk Sweet.—A Munich chemist, M. NEUMANN, points out that the electric state of milk, as affected by the bodies with which it comes in contact, exerts an unquestionable influence over its keeping. Milk which has stood in a tin vessel, and is turned out into glass or pewter, will not keep sweet so long as if left in the tin. Milk will keep well in zinc, antimony, bismuth, copper, brass, or iron vessels; but iron is apt to impart a disagreeable taste; and copper, after a while, is found in notable proportion in the milk. Caution is, therefore, requisite with utensils of this metal. Block-tin vessels are best; but the milk should not be shifted from vessel to vessel, and the latter should be filled as full as possible. *Stummer's Ingenieur, 19th February*, 1875, *from Bern. Blätt. für Landwirthschaft.*

Haarlem Oil.—This oil, so long esteemed in Holland as a remedy for affections of the bladder, and the preparation of which has been kept a secret, is found to be of variable composition, containing admixtures of turpentine, sulphur, &c., with juniper oil. Dr. Arnal's "Genuine Haarlem Oil" contains equal parts of juniper-wood oil and juniper-berry oil. The mode of distillation is not stated. Taken internally, the daily dose is 80 centigrammes divided into four. *Indust.-Blätt. 21st Jan.* 1875.

Meat Extracts as Substitutes for Spirituous Liquors.—Professor PARKES of the Royal Victoria Hospital, Netley, shows, from the medical experience of the Ashantee campaign, that alcohol, although sometimes a useful stimulant, is not a renovator; when its effects have worked off, a depression and state of lassitude follows, leaving the soldier in a worse condition for fatigue or exertion than before. Finding that spirits are injurious to soldiers on the march, Dr. Parkes has sought to discover something which would act, not only as a stimulant, but as a renovator, in the sense of supplying materials to exhausted tissues. This, he thinks, is to be found in meat-extracts, which remove the sense of fatigue by supplying directly, in part at least, the materials wanted, viz. the special potash salts and probably animal extractive matters, which have a reviving effect on the exhausted nerves. In connection with this idea, three intelligent and trustworthy soldiers selected from Netley, marched a distance of 20¼ miles, in complete marching

order, for six consecutive days, receiving during their intervals of rest rum, coffee, or extract of beef. The effects of the spirit disappeared after 2½ miles had been got over, and when a second allowance was given, its revivifying effect was not only less than the first had been, but it made them sleepy and disinclined to walk at all. Coffee was far before the rum, but inferior to the extract of beef, which last both satisfied hunger and gave renewed strength to the men, so that upon it they performed the 20½ miles march with far more ease than they were able to do otherwise. *Colburn's United Service Magazine, Feb.* 1875.

Cider from Apples and Beet-root.—M. PLOUARD makes a very good, clear, wholesome cider, which keeps well, by mixing 5 kilogs. of beet-root chopped small with each hectolitre of apples (1 lb. of beet to 2 galls. of fruit). The mixture is steeped in water for forty-eight hours before pressing. White beet is found better than red for the purpose. The cost of cider thus made (at Andelys) is stated not to exceed 4 fr. per hectolitre (2*d.* per gallon). *Les Mondes, 25th Feb.* 1875, *from Gazette des Campagnes.*

Castor-oil Cake as a Manure and Insecticide.—At a recent meeting of the Agricultural Society of Turin, the use of castor-oil cake was mentioned as a remedy for the *Phylloxera vastatrix* and the *Doryphora decemlineata*, or Colorado potato-beetle. It is stated that castor-oil cakes have been employed successfully in destroying field-mice, and that in Central Italy they have long been used both as a manure and as a means of destroying certain insects that infest hemp. *Industrie-Blätter*, 18 *Feb.* 1875, *from Pharmacie-Zeitung.*

§ 5. *Fuel, Heating, Illumination, &c.*

Influence of Atmospheric Pressure on Combustion.—By experiments with a small apparatus, which enabled him to subject various flames to a pressure of 30 to 35 atmospheres, M. CAILLETET found that the temperature of combustion is increased by an increase of atmospheric pressure, without the latter necessarily being very great. A wax candle subjected to this increased pressure at first burned much brighter, but subsequently became merged in a cloud of thick smoke. A phosphorus flame was not perceptibly brightened by increased pressure. Sulphur gave a much deeper coloured flame. Potassium, a very brilliant flame of a violet colour. A spirit lamp with a small cotton wick, affording a scarcely perceptible light, increased rapidly in brilliancy as the pressure was augmented; under a pressure of 18 to 20 atmospheres the flame was as white and brilliant as that of a wax candle. Sulphide of carbon also gave a much brighter flame under pressure than in common air. It was discovered that not alone the intensity of the luminous rays, but the activity of the chemical rays as well, increased with the atmospheric pressure. Certain substances, which become phosphorescent by sunlight, were placed in a dark box, and illumined in turn by the several flames through tubes provided for the purpose. Some, which were unaffected by a particular flame under ordinary pressure, became phosphorescent when exposed to the rays of the same flame burning under increased atmospheric pressure; and others, which were phospherescent when exposed to a particular flame in common air, displayed a conspicuous increase of phosphorescence as the atmospheric pressure on the flame was increased. *Comptes Rendus, lxxx.* 8, 1875.

"Acide Extincteur."—ZAPFLE, represented by Armengaud of Paris, patents the following composition, to be mixed with water for extinguishing fires, in the proportion of 10 kilogs. of acid per hectolitre of water:—82·4 kilogs. hydrochloric acid, 3·5 crystallized alum, 30 litres of water. This will make 100 litres of acid, to which should be added 5 kilogs. of quicklime, to neutralize its injurious action on the pumps. It should be allowed to stand for six hours before it is stored for use. *Bulletin de la Soc. Chim. de Paris, xxiii. 5th Feb.* 1875.

Coke from Compressed Turf.—M. BATD states that by drying, pressing, and coking turf, a coke can be produced, containing 70 to 96 per cent. of carbon, with a sp. gr. of 1 to 2, and a calorific power equal at least to that of ordinary coke, at 50 per cent. less cost.

The turf bed is first divided into rectangular compartments, and drained by ditching, pumping, &c. The turf is then torn up with a sort of harrow, or it may be cut by hand, and carried to the drying-houses, where it is dried on iron floors heated by steam-pipes, until it contains no more than 10 per cent. of water. Next it is pressed into half-pound cakes by steam or hydraulic pressure. Lastly, these cakes are coked for four days in a Hoffman's oven. The heat produced in the coking process, it is estimated, will be sufficient to supply the motive-power for the machine-cutting, carrying, and pressing of the turf. Peaty is better than fibrous turf for the purpose, as the closer-grained the material, the more compact will be the coke. About 120 tons of turf are required to produce 50 tons of coke, the value of which is estimated at 800 to 900 francs. Not more than about half or one-third of the produce will be fit for the market. *Technologiste, January*, 1875, *from Polytech. Centralblatt.*

Comparative Values of Petroleum-gas and Coal-gas.—Professor WAGNER gives the following estimate of the comparative illuminating powers of gas prepared from petroleum and from coal:—

Centner.		Cubic Feet of Gas.		Kilogs. Stearine.
1	of Petroleum produces . . .	1500	=	136
1	Boghead coal produces . .	731	=	51·2
1	Bohemian "Pankritz Platten" produces	603	=	28·3
1	Falkenau coal produces . .	575	=	27·6
1	Saarbrück coal produces . .	519	=	10·9

To produce an illuminating power equal to that of 136 kilogs. of stearine, we therefore require—

1	cent.	of Petroleum.
2·6	„	Boghead coal.
4·8	„	Bohemian Pankritz Platten.
4·9	„	Falkenau coal.
12·5	„	Saarbrück coal.

Bayerisches Indust.-und Gewerbe-Blatt, January, 1875.

Glycerine for Illuminating Purposes.—Glycerine boils at 150° C. At a higher temperature it sublimes into a soft, porous mass, emitting a strong odour of acroline. Thrown on hot coals it burns with a blue flame and a very strong smell of acroline. It has been found that pure glycerine at a temperature of 150° C. will burn with a bright inodorous flame. A cotton wick placed in it burns without smoke or smell. The illuminating power of glycerine appears equal to that of proof spirit, and as the former is neither volatile nor dangerous, and of moderate price withal, it is probable that it may, in very many cases, prove an advantageous substitute for the latter.

Carbolic acid burns with a very smoky flame, but a cotton wick placed in a mixture of carbolic acid and glycerine was found to burn without smoke, giving a very bright light. *Indust.-Blatt. 21st Jan.* 1875.

M. SCHELLING has lately communicated to the Berlin Apotheker-Verein the results of similar experiments. He finds that glycerine may be burned with any lamp where the flame is immediately over the combustible, as a Berzelius lamp. It admits of a question, however, whether the consistency of the glycerine might not prove unfavourable to steady combustion. Trials with mixtures of glycerine and various substances rich in carbon would prove interesting. A useful combination might be made with glycerine and fusel oil. *Indust.-Blätt. 21st. Jan.* 1875.

Earthenware Stoves and Grates.—The undermentioned journal directs attention to the stoves and fireplaces manutured by Muller et Cie, of Paris, from the designs of Professor Muller, of the Ecole Centrale. The stoves are formed exclusively of terra-cotta, whereby the ill effects arising from the production of carbonic-oxide gas, the excessive desiccation of the air, and the carbonization of the organic particles contained therein are completely avoided. The weight of these stoves ranges from 135 to 230 kilogs. (280 lbs. to 480 lbs.), and the price from 120 to 16 francs.

The fire-places with open grates are made entirely of earthenware enamelled. A fireplace of this description, measuring 55 centimetres × 45 centimetres × 85 centimetres, weighs 100 kilogs., and costs 50 francs. *Technologiste, February*, 1875.

§ 6. *Miscellaneous.*

Gum-Tragacanth.—M. GIRAUD communicates the results of researches into the chemical composition of various gums, particularly gum-tragacanth. He finds that gum-tragacanth contains more than half its weight of insoluble pectic principle, believed to be identical with that termed by M. Fremy *pectose*, which is known to exist in the utricular tissue of fruits and roots. Gum-tragacanth is soluble to a very small extent only in cold water. It is not correct that it contains 30 to 50 per cent. of soluble gum. Digested with 50 times its

weight of water in a sand-bath, it forms a soluble gum, which has lost the property of swelling after desiccation. This is pectine. Treated with weakly acidulated water in a sand-bath, it becomes soluble. The product formed consists principally of pectine, and precipitates with alcohol. The alkaline principles from it are transferred into pectates and metapectates. The following results were given by analysis :—

Gum-tragacanth :—	
Water	20 per cent.
Pectine	60 „
Soluble gum	8 to 10 „
Cellulose	3 „
Starch	2 to 3 „
Mineral substances	3 „
Nitrogenous substances	traces „
	100

Comptes Rendus, lxxx. 8, 1875.

Bottles for Effervescing Drinks.—O. CH. OLSEN, of Christiania, patents (in Denmark) a new glass stopper for bottles containing effervescing drinks, which from the accounts given would appear to be a useful invention. It fits easily, forming an air-tight fastening, but by a change of position allows the contents of the bottle to be drawn off from time to time, in any desired quantity, like the so-called syphons of soda-water machines. *Industri-Tidenden (Copenhagen), 3rd Jan.* 1875.

New Apparatus for Fractional Distillation.—An apparatus, invented by M. GLINSKI, has been in use for over twelve months in the laboratory of the University of Kasan. It is provided with a certain number of platina-wire screens (5 or 6) arranged in a vertical tube. The dimensions of the apparatus and number of metallic screens may be varied according to the purpose to which it is to be applied. *Bulletin de la Soc. Chim. de Paris, xxiii.* 4, *from Bulletin de la Soc. Chim. Russe.*

Käseleim-pulver.—The use of curds from cows' milk, mixed with lime, as a putty for mending domestic articles of all kinds, has long been known. In the German cantons of Switzerland, a similar compound of cheese and slaked lime is used, under the name of "käseleim," for laying floors, puttying joiners' work, making blocks for hand-printing cotton and tapestry goods, and other like purposes. The material sets so rapidly, that it is necessary to mix it as the work goes on, which entails trouble and necessitates a certain knack in its use.

A Swiss chemist, M. BRUNNSCHWEILER, of St. Gall, has invented a preparation of lime and skim-milk, to which he gives the name of "Käseleim-pulver," whereby these inconveniences are avoided. It is a very fine, dry powder, which keeps well, and for use only requires mixing with water, when it displays all the properties of ordinary quicklime. It sets quickly, and hardens with age. Professor Gintl, of Vienna, reports most favourably of the preparation. It is sold by C. Baumgartner and Son, of St. Gall. *Bayerisches Ind. und Gewerbe-Blatt. Jan.* 1875, *from Gewerbe-Blätt. aus Würtemberg.*

Paraffin in Paper Manufacture.—Dr. BOHL observes that paraffin is likely to attain a considerable importance in the manufacture of glazed papers of all kinds. For white and delicate coloured papers, 24 parts by weight of paraffin are mixed with 100 parts of china-clay ; the compound is dried, and ground with cold water, and mixed with the pulp in the proportion of 4 to 6 per cent. Paper thus prepared takes a fine satiny gloss, and resists the damp well. *Industrie-Blätter, 28th Jan.* 1875, *from Muster-Zeitung.*

Petroleum Apparatus for Artificial Incubation.—M. KRANTZ ("Anleitung über das künstliche Brüten," Berlin, Gerschell) recommends a small apparatus, heated with petroleum, by which five dozen of eggs may be hatched artificially at once. In a three weeks' incubation the apparatus consumes about a shilling's worth of petroleum. Complete, with wooden case, heater, and thermometer, it costs 5 thalers (15*s.*) *Indust.-Blätt. 21st Jan.* 1875.

Consumption of Flowers in Perfumery.—A single manufacturer (Hermann) at Cannes uses annually 140,000 lbs. of orange blossoms, 129,000 lbs. of acacia flowers, 140,000 lbs. of rose leaves, 32,000 lbs. of jasmine flowers, 20,000 lbs. of violets, 8,000 lbs. of tuberoses, besides rosemary, mint, thyme, lemons, citrons, &c. in proportionate quantities.

Nice and Cannes together consume annually over 20 tons of violets ; Nice alone 190 tons of orange blossoms ; Cannes over 150 tons of acacia flowers. *Dr. Wagner, Jahrbericht über chem. Tech.*

Tuscan Straw Manufactures.—The straw used for plaiting differs in character and mode of growth from ordinary straw. The grain is sown in the month of March—hence the name given to it, "marzuolo." The manufacture of hats is carried on chiefly in the provinces of Vicenza and Bologna, and in Tuscany. Although an ancient industry, it may be said to have been first developed in the eighteenth century, when Sebastian Michaelacci of Bologna commenced the exportation of Tuscan hats to foreign countries. The reports lately collected by the commissioners deputed to inquire into the condition of Italian industries agree in representing that the trade has increased within the last ten years, but the increase has been in the inferior descriptions of goods. This is a consequence of the caprice of fashion. Everywhere the feminine fashions are copied from those of Paris, and Parisian taste has always been unfavourable to this branch of industry. For the last twenty years past the export of split straws has ceased, as plaiting in the English and Swiss fashion has come into practice in Florence. The Italian exports of straw-plaits and hats, during the year 1872, were as below. [Lire are equal to francs.]

	Weight. Kilogrammes.	Value. Lire.
Fine plaits	382,720	14,543,360
Coarse „	106,300	637,800
Straw hats under 5 lire in value	3,312,000	11,592,000
Ditto over „	14,500	108,750

The total declared value of the imports under the above head during the aforesaid year therefore amounted to 26,881,910 lire, or over a million sterling. *L'Economista, 7th March,* 1875.

Silk Waste as an Agent for removing Foreign Bodies from the Eye.—A medical correspondent of the *Lancet* (13th March, 1875) makes a suggestion which may prove useful on emergency to some of our readers. He says :—

"In consequence of the difficulty I experienced in removing from a patient a portion of steel deeply bedded in the cornea, which did not yield to spud or needle, some other means of removal became necessary. Dry, soft, white silk waste suggested itself to me, and was wound round a thin piece of wood, so as to completely envelop its end. This soft application was brushed once backwards and forwards horizontally over the part of the cornea where the foreign substance seemed fixed. To my astonishment it was at once entangled by the delicate but strong meshes of the silk, and was withdrawn with the greatest ease, caught by the same. A gentleman in turning steel at a lathe suddenly felt that a portion had entered his eye. He went at once to a surgeon, who with the most skilful manipulation failed to extract the same, saying it would soon work out of itself. The next morning the patient saw me, having suffered severely since the accident, and on the first application the portion of steel was extracted."

Electricity in Thermal Waters.—Professor THURY of Geneva and Dr. MINNICH of Baden, by experiments with a galvanometer of large size at the thermal spring at Stadhof, obtained the following results :—

No. 1 series showed that the water on escaping from the ground was pretty highly charged with electricity ; also, that this electricity was negative.

No. 2, that the said mineral water indicated the presence of negative electricity whilst warm, but that the oscillations of the needle became less as the water cooled, until they ceased altogether when the water was nearly cold. Subsequent experiments showed that this reduced power of developing electricity was *not* the consequence of polarization.

No. 3 showed that thermal water, which has cooled, does *not* recover its property of developing electricity by being heated afresh.

No. 4 showed that the results in experiment No. 2 were not due to thermo-electric action, nor to the action of the carbonic acid on the platinum electrode. *Archives des Sciences de Genève, 15th Jan.* 1875.

Ginesta (Broom) for Cordage.—MIRAGLIO states that in the southern parts of Italy—Calabria and the Basilicata more especially—and in Tuscany, a variety of ginesta, *Spartium junceum*, or Spanish broom, is much used for cordage, coarse baggings, &c. Not only is it cheaper than flax or hemp, but lighter and stronger as well. In some parts of France it is used for the same purpose. Another variety, *Spartium scoparium*, or common broom, grows plentifully in Italy, and furnishes an abundance of fibre, but there appears to be a prejudice in favour of the Spanish broom. *L'Economista (Florence and Rome), 7th March,* 1875.

ON PEAT.

IN a recent number of the "Bulletin de la Société d'Encouragement de l'Industrie," M. KOLB publishes a very interesting and suggestive paper on the result of his investigations into the above subject, relating more particularly to the peat found in the valley of the Somme. We give the following abstract of his paper, as every contribution to our knowledge on the subject of fuel should command the serious attention of the industrial community.

Peat has its disadvantages; we all know them: its smell, its lightness, its humidity. But it has also its advantages; and among the first of these is, that it is a fuel which can be cultivated almost without expense. This cultivation will give, for equal surface of land and an equal time, a calorific return greater than that of wood. It has been well proved that in 30 to 40 years a peat moss will produce a thickness of one metre of excellent peat; and the growth might be made more rapid, if proper attention and study were given to its laws.

The origin of peat is now well known. Between anthracite (which is nearly pure carbon), and the plant growing before our eyes, there is a sort of complete scale, an unbroken chain of substances formed by decomposition of the plant-systems that have successively covered our planet. These plants have died, one set after another; they are altered less and less profoundly as we pass upwards, so that, from the anthracite, or pure carbon, which is the extreme limit of decomposition, we pass gradually to poor coal, then to oily coal, then to lignites (which are, so to speak, imperfect coal, in which the plant-form is still intact). From lignite to peat the transition is as gradual; from peat to the living plant the distinction is almost *nil*.

This gentle gradation appears in chemical, as well as in physical, features, or external aspect. Thus the living plant is attacked at once by alkaline solutions, by acids, and by hypochlorites; peat, still soluble in hypochlorites and alkalies, resists the action of hydrochloric and sulphuric acid. Lignite is still soluble in hydrochlorites, but does not yield to alkalies. Coal is not attacked by any of these re-agents, except concentrated nitric acid. I have also found that our peats do not contain any principle soluble in water, ether, or alcohol.

Anthracite and coal are formed from flora in the strata of transition; lignite from plants of the tertiary epoch; peat is formed in the present epoch by decomposition of plants now living. It is formed by plants, the decomposition of which is retarded by the presence of water, which protects them from the contact of air.

Peat has nearly always for its first layer the débris of trees. The trunks decompose gradually in the bottom of marshes. Then plants which can only live on wood in decomposition (*i.e.* in an acid medium), spring up, envelope the trunks, complete their growth, and deposit the detritus of their leaves. This detritus, accumulated each year, forms peat, and serves as the soil of a new vegetation, which grows and dies in its own turn, so that the peaty surface gradually rises, and by and by ceases to be immersed in water. Peat mosses always require the presence of ponds, lakes, or arms of the sea.

It is easy to see why quiet but current water is favourable to the production of peat. Where water is stagnant, the decomposition of the plants is complete, and gives only a sort of mire, humus. If the current, again, is too rapid, it carries away the detritus of vegetation, and the first material being removed, the production is arrested. Hence peat mosses do not exist in the current of streams and rivers, but only in the neighbourhood of such.

The peat flora of each country seems now pretty well known. In Picardy we find two sorts of peat; compact peat, arising from débris of trees and large plants; and mossy peat, from decomposition of horse-tails, rushes, and mosses which have grown on the compact peat. At certain times inundations take place, bringing large quantities of mineral matter, which is retained in the pores of the peat, giving rise to a third species of peat, distinguished by its large proportion of ash.

To study peat comparatively, it is necessary first to dry it. For when extracted it is somewhat like a sponge full of water. Exposed to air under a shed, it gives up some of its water, still retaining, however, a large portion (which varies according to the nature of the peat). The mineral element in peat keeps little water, the vegetable element much; so that, in general, peat is more hygrometric the more vegetable matter it contains. I have observed that each peat has (so to say) its special hygrometric coefficient; a coefficient which is hardly caused to vary by exposure to air. Thus, if we take a peat which, after having been under a shed during summer, contains 18 per cent. of water, we may dry it completely in a stove heated to 80 degrees C. But if we put it again under the shed, it takes up again the 18 parts of water that had been expelled, and keeps the quantity almost invariably for an indefinite time. Hence a person in our district might purchase one peat at Long, another at Etoile, supposing that, the conditions of drying having been the same, both peats would have nearly the same quantity of water; whereas the one would have 30 per cent. and the other only 15. Humidity, therefore, is an important feature.

In our country, the method of drying peat is still the primitive one of exposure to air. In Germany, where peat is largely used for metallurgical purposes, there is often sacrificed one-tenth of the peat extracted in order to dry the rest as thoroughly as possible.

A temperature of 80 degrees for two days will dry peat thoroughly. I have remarked that our peat may be subjected to a temperature of 100 degrees without disadvantage; there is no decomposition (as has been supposed), no escape of carbonized gases, or of nitrogen, only expulsion of water. Hence these peats might be dried on our steam boilers.

After bringing our peats into a comparable state by drying, I studied their relative weight. The weight of a cubic metre of peat is an excessively elastic datum, and must not be confounded with the absolute density of the peat. The absolute density of our peat is, on an average, 1,405, that is, a cubic metre filled with peat, without leaving any empty space, will weigh 1,405 kilogrammes (which is also the density of the best kinds of coal).

Now taking 1 cubic metre of dry peat finely bruised, there are, of course, empty spaces between the particles, and the weight of this cubic metre varies, in our peats, from 320 to 640 kilogrammes; average 496 kilogrammes. Lastly, if we take a cubic metre of *briquettes* of peat, the empty spaces between the briquettes are added to those between the peat particles, and such a cubic metre weighs, in our district, on an average, 360 kilogrammes.

The small weight of peat is perhaps the most serious obstacle to its industrial use; it is cumbersome fuel, light and spongy, and so burns very quickly. But this is not without remedy; and in some parts of France, by artificial preparation, briquettes are obtained more dense than coal itself, burning as vigorously, and so hard that they can be wrought like wood.

Let us now consider our peats with reference to their combustion, and the residue of this. It is generally said that peat gives a great deal of ash. This is a mistake; many of our peats burnt in the dry state leave only 8 to 9 per cent. of ash. Thus they are not inferior, in this respect, to most of the coal used for furnaces. They have even the advantage over coal of falling in fine powder, and not producing scoriæ or dirtying the grate. Our peat compares favourably, in respect of ash, with that in other countries. (In Mansfeld, the proportion is 29 per cent.; in Italy it varies from 17 to 34. In many other districts it is 15 and upwards.)

Next, as to calorific power. It is known that one kilogramme of pure carbon has a calorific power represented by the number 7,224, *i.e.* it will heat 7,224 kilogrammes of water 1 degree. A kilogramme of coal of the best quality has a calorific power of 6,000; the wood of dry oak not more than 3,500. From experiments on peat I have arrived at the result, that our good peats, dry, have a calorific power varying from 3,100 to 3,500, *i.e.* nearly that of dry oak. Hence, in round numbers, one might replace coals of the first quality, in a given furnace, by twice their weight of good dry peat. It results also, that any industry which uses wood might employ peat in equal weight; for the radiating power of our peat, as well as its calorific power, is the same as that of dry wood.

Our combustible peat can be divided into two elements; it contains 60 per cent. of inflammable gas, and 40 per cent. of a coke formed of 31 parts of pure carbon, and 9 parts of ash. The calorific power of these peats being 3,300, I have ascertained that the coke furnishes 2,150 or about two-thirds; the gas, 1,150 or one-third.

The coke, or rather the charcoal of peat, presents a great advantage over peat as to density. The cubic metre weighs 410 to 430 kilogrammes; that is to say, it is heavier than the cubic metre of our cokes from coal, and its calorific power varies from 5,400 to 6,800. Where the peat is pressed (as at Essonne), its coke weighs 700 kilogrammes per cubic metre, or twice as much as the coke of coal, and its calorific power reaches 7,400, that is, exceeds by 12 per cent. that of the coke of our gas manufactories. We see, then, the advantage of peat under this form.

We may affirm, I believe, that it is in the carbonization of peat that its true future lies, especially where it has been purified and moulded previously. A dense, coherent fuel is thus obtained, comparatively without smell or smoke, capable of giving

high temperatures, and, in any circumstances, rivalling the best coals.

Besides useful fuel, the carbonization of peat furnishes an abundant and valuable gas. It yields about 60 per cent. of its weight of gas; which, indeed, is but slightly luminous, but can burn and develop high temperatures. From M. de Marsilly's analyses, it appears that the gases liberated from peat contain nearly 40 per cent. pure hydrogen, 30 per cent. carbonic acid, 11 per cent. carbonized hydrogen. That is to say, 81 per cent. of three bodies capable of giving a very high temperature by their combustion. To this must be added (it is true) 14 per cent. of carbonic acid, a proportion which destroys, by its sole presence, almost all luminous power, but which might easily be removed, for it is chiefly at the beginning of the distillation that carbonic acid is given off.

This once removed, the gas of peat becomes a very powerful and convenient metallurgical element; it has the advantage of being free from sulphur. Its value is now largely appreciated in certain countries, especially in puddling and refining iron.

Distillation of peat, then, gives good coke and the above-named useful gases. It further yields a proportion of 2 per cent. of ammonia (which I have found almost constant in our peats of best quality). This proportion alone gives peat a value of 1 fr. per 100 kilogrammes (a fact not appreciated hitherto). Ammoniacal salts are now greatly in demand for agriculture. They are nearly all extracted from urine, or the ammoniacal water from ordinary gas. Now, to obtain 2 kilogrammes of ammonia, it is necessary to procure about 800 litres of urine, or to distil 1,000 kilogrammes of coal; whereas, one may produce it by simple carbonization of only 100 kilogrammes of peat. A producer of ammoniacal salts, then, would find in peat the richest and most advantageous material, from all points of view.

While the best peats yield 20 kilogrammes of ammonia per ton, those of the second quality contain 17 kilogrammes, and those of the third, or the ashy peat, 11 kilogrammes (which is allowed to escape in smoke, though much more valuable than the ashes, which alone are sought).

Distillation of peat gives various other products, and, especially, 6 to 7 per cent. of tar, with a very penetrating odour, very rich in phenic acid and paraffin, and also in acetic acid and in wood spirit. This tar resembles more that of wood than that of coal; it is, therefore, of more value than the latter.

The ashy peats are not used in our country as fuel; their calorific power is very variable (from 600 to 2,000 calories, or from a tenth to a third the power of coal). They are burnt in open air for the sake of the ashes, which are a good deal used in manuring. For such a product to sell at so good a price as 15 francs the stere, it ought surely to contain some substances very advantageous in agriculture, either phosphates, or sulphate of potash, or soda. After many careful analyses, I have found only insignificant traces of such salts. The ashes contain only three sorts of elements: chalk, plaster, and ferruginous clay. The simultaneous presence of plaster and oxide of iron leads one to suppose that the plaster is formed in consequence of pyritous decomposition. These three substances are in very various proportion in the peat. They might be furnished to agriculture without having recourse to peat-mosses. I made an estimate of the price of a hectolitre of peat ash and that of a perfectly similar mixture of the three substances, plaster, chalk, and clay, from other sources. It appeared that the peat ash of the best quality sells at about a fourth less than its real value, while the worst quality is sold at double the price its constituents would warrant. Thus, in the present mode of sale of peat ash, there is a certain coefficient of chance, and it seems to me to be generally advantageous for the purchaser.

Is combustion in the open air the best way of utilizing the ashes of peat? I believe, on the contrary, it is the most defective. The peats contain an enormous quantity of insoluble ulmine, and it would be, I think, an interesting question to study what are the best circumstances for transforming this ulmine into soluble and insoluble humus.

Ashy peats, then, may furnish to agriculture an abundant mould, containing 1 per cent. of nitrogen. It is often all burnt to obtain the ashes: what is sought in these ashes is the plaster and the clay. But both pre-exist in the peat, and would act, I believe, quite as efficaciously mixed with the ulmine and the azotised matter, as when they are isolated by combustion.

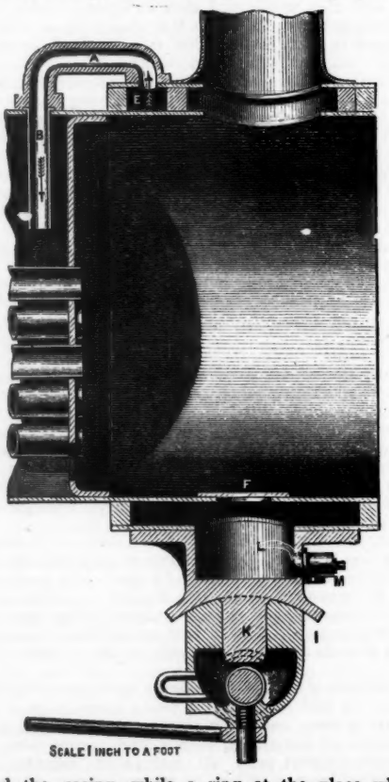
As to the chalk, it does not pre-exist entirely in the peat. What we meet with in the ashes in the state of peat is found, in great part, in the peat in the state of ulmate of lime, and it is the combustion that changes the ulmate into the carbonate. Thus, in an analysis I made, 1,000 kilogrammes of the peat contained 16 kilogrammes of carbonate of lime; the rest of the lime was in the state of sulphate and of ulmate. After calcination, the quantity of sulphate did not vary, but instead of 16 kilogrammes of carbonate of lime, there were 54.

Thus, in burning peat in the open air to obtain the ashes, one transforms ulmate of lime, which has an agricultural value, into chalk, which has much less, and one loses, in the process, all the ulmine and the azotised products. Abandoning this combustion of poor peat, and simply spreading it in form of powder, there would be no loss; one would gain, on the other hand, in mould and nitrogen, that is, in fertilizing power.

Peat is now extensively employed (the author concludes) for various industrial purposes, and it would seem as if other countries had got beyond the period of infancy, ignorance and hesitation, with regard to it, in which we appear still to remain stationary; yet analyses show that our peat will easily rival those with which wonders are being obtained elsewhere.

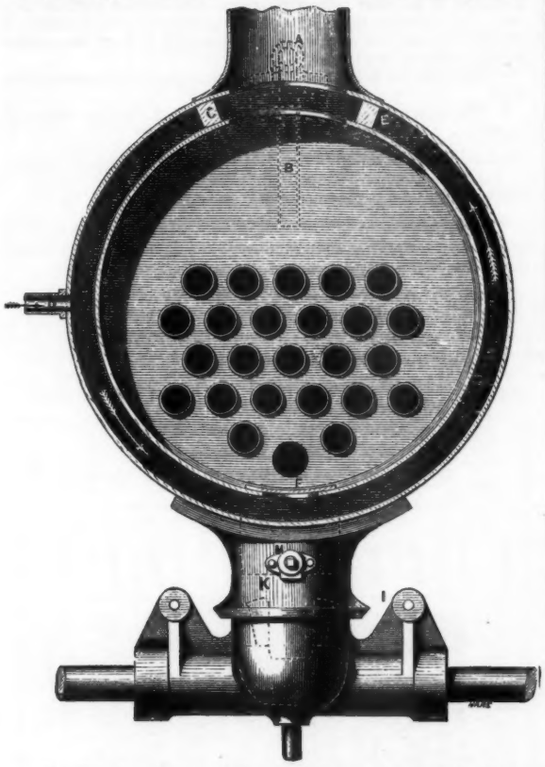
FEED WATER HEATER.

ONE of the most approved methods of saving fuel in steam machinery is to transfer the heat, either contained in the exhaust steam from the cylinder, or that passing up the chimney from the furnace, into the feed water, as it is being forced into the boiler. Many plans dealing with both the above are in practical working, with more or less good results. We illustrate a very excellent one, patented and made by Messrs. Alexander and Sons, Cirencester. It will be seen that the heater consists of a casing surrounding the smoke-box of the boiler, an annular space existing between the



box and the casing, while a ring at the place where the funnel is fitted makes all tight there. The water is sent in through the pipe D, and the arrows show its transit through the heater to the boiler feed-pipe A B. A mud chamber, L, is fitted at the bottom of the heater, and here all the mud and sediment thrown down by the feed collects; thus the water is fed quite pure into the boiler, whose tube and plate surfaces are thus preserved free from deposit. The sediment collected in the chamber can be discharged as often as requisite from it through the cock M. The purified water passes in the direction shown by the arrow to the point E; the pipe B conveying it below the water-line of the boiler, thus preventing air or steam forming in the heater. The feed is usually sent into

the boiler at 212°, or boiling point. A sort of man-hole and cover are fitted at F, so that the mud chamber can be examined and, if necessary, scaled from time to time, and the mud chamber



casing K is formed to constitute the fore-carriage of the boiler. We have a high opinion of this feed heater, and feel very certain that it will yield satisfactory results wherever it is used.

STEEL-BRONZE.

MAJOR-GENERAL VON UCHATIUS (who, since his promotion to general's rank, has retained, provisionally, his post of director of the Imperial Arsenal at Vienna), gives this name to bronze prepared by a method discovered by him a short time since.

About two years ago the Archduke Wilhelm, director-general of the Austrian artillery, brought with him from Russia a sample of bronze which had been compressed in the liquid state, and which proved greatly superior to the bronze then used for Austrian field-guns. General von Uchatius found that by submitting a bronze of 90 per cent. copper and 10 per cent. tin to a pressure of 80,000 kilogs., immediately after it had been cast into moulds, he could produce a bronze equal to the Russian sample. At the same time (1873) Lavessière, of Paris, exhibited at the Vienna Exhibition bronze and bronze guns obtained by chilling the metal in moulds. The "chilled bronze," although a great improvement, was deficient in elasticity and hardness. To overcome these defects, General von Uchatius proposed to roll the "chilled bronze" while cold. The results of his experiments showed that it was possible to roll the chilled bronze when cold up to an elongation of 100 per cent. without the least crack being visible; and that with an elongation of only 20 per cent. the bronze obtained the hardness, elasticity, and strength of steel—hence the name given to it: "steel-bronze."

The experiments also brought to light a fact of the highest importance in metallurgical industries, viz., that the elasticity of all tough materials increases rapidly after these have been subjected to a force exceeding the elastic strength of the material. Thus, chilled bronze reaches its elastic limit under a strain of 400 kilogs., corresponding to an elongation of 0·0004 of the original length, whilst after having been submitted to a tension corresponding to a permanent set of 0·004 of the original length the elastic limit of the material is raised to 1,600 kilogs., with a corresponding elastic elongation of 0·00192 of the original length. After a careful consideration of results, General von Uchatius arrived at the following conclusion:—The work done by the powder in the powder-chambers to the detriment of the guns must be anticipated in the manufacture of the gun by compressing the interior of the bore mechanically to a degree exceeding that produced by the explosion of the powder, and thus raising the elastic limits of those portions which have to resist the force of the explosion, *i.e.*, the material about the bore must be treated in a manner analogous to the rolling process above spoken of, until the requisite degree of hardness is obtained.

But before beginning the manufacture of a gun on this principle, he instituted experiments to determine—1. What sort of bronze alloy is best suited to the purpose; 2. Can the quality of the material be made uniform throughout the casting, in the centre as well as at the circumference.

For the solution of the first question, a small cast-iron ingot was filled with the following alloys:—

1.	12	per cent. tin	and 88	per cent. copper.	
2.	10	"	90	"	
3.	8	"	92	"	
4.	6	"	94	"	
5.	10	"	88	"	and 2 zinc.
6.	10	"	89	"	1 "
7.	8½	"	91	"	½ " (the alloy used by Lavessière.

Two small bars were cut from each ingot, rolled out until they acquired the hardness of steel, and tested. The results showed that the 10, 8, and 6 per cent. bronzes were all suited for the purpose, and that the addition of the zinc was of no appreciable utility. Uniformity of quality throughout the casting was only attainable by simultaneous inside cooling, *i.e.*, by the chilling of the bore. A current of air and a stream of water having respectively proved unsuitable for this purpose, solid cores of various metals were tried, and it was at length found that by using *wrought-copper* cores of 50 mm. diameter, perfectly good and reliable results could be attained.

The drilled hollow ingots were then subjected to the following treatment:—They were bored out to a calibre of 80 mm., with an outside diameter of 260 mm., and were each 300 mm. long. At one end, the outside was turned to a diameter of 180 mm., corresponding to that of a finished field-gun, and the hollow ingot was placed vertically upon a circular base-plate with a corresponding hole, and a conical piston of hardened steel was forced through the tube by means of a powerful hydraulic press. As the tube opposed a resistance which increased with the widening of the bore, the difference in the diameters of the conical pistons following each other had to be reduced accordingly, so that with six pistons forced through the bore, the first one had a diameter 2 mm. larger than that of the bore, whilst the last was only ½ mm. larger than the preceding one. By this process the bore, which originally had a calibre of 80 mm., was enlarged 2 per cent. Its surface, when tested with the compressor, showed a hardness equal to that of gun-steel, and it was also observed that at the turned portion of the tube the interior had acquired the same hardness as the rest of the bore.

This mode of manufacture possesses the additional advantages that by it all unsound parts are easily detected, for wherever there exists a fault in the material, or where the bronze is not of perfect quality, the act of drawing immediately produces cracks and fissures. Another highly important point is the fact that after the piston has been forced through the bore, the diameter of the latter contracts to 0·004 of the diameter within the elastic limit, proving that the different parts of the gun are in a state of elastic compression, which equals, according to careful calculations, a radial central pressure of about 2,400 atmospheres. To prove this elastic compression to be acting throughout the whole mass, General von Uchatius had a ring turned off one end of the tube until a small circle of metal on the inside of the tube alone kept the ring on the main tube. Before the chisel severs this last connecting circle, the ring spontaneously springs off, and shows a smaller calibre bore than the tube from which it was taken.

The 8 per cent. bronze appears to be best suited to the manufacture of guns, as the inner chilling can be effected much more easily than with the 10 per cent. bronze, and does not require the addition of so much copper as the 6 per cent. bronze. It is also the cheapest of these three alloys.

The difference between the "steel-bronze" guns and the steel guns hitherto in use are thus summed-up:

1. Guns manufactured as above described can only be compared to coiled steel tubes, as they have the same degree of hardness, homogeneity, and strength in the bore as the latter, and as the radial pressure to the centre of the gun is obtained beforehand by the treatment of the material itself.

2. The quality of the bronze varies from the outside to the bore in direct proportion to the stress the gun has to bear. The elasticity of the inner parts and the toughness of the outer surface are far greater than that of steel.

3. The neutral axis, where the explosive force of the charge and the opposing elastic pressure of the material are in equilibrium, lies very near the bore in steel-bronze guns. To make such a gun fly to pieces the elasticity of the whole material must be overcome simultaneously, and then the great toughness of the outer portions, bearing extension to 70 per cent. without breakage, would still offer opposition to the explosive force. In coiled guns, on the contrary, the neutral axis lies between the tube and the coils, and the latter have to bear the full force of the explosion.

4. As to the abrasion of the inner surface of the bore, an inspection of M. Tilghmann's sand-blowing machines at the Vienna Exhibition has led the general to believe that chemical reactions have nothing to do with the pressure, which he supposes to be caused by the mechanical action of the unburned particles of powder. As steel-bronze guns do not contain any zinc, which is liable to form spots containing a greater percentage of zinc than the rest of the gun, the abrasion will not be greater in them than in steel guns.

5. Steel-bronze is less affected by atmospheric influences than steel.

6. The cost of manufacture is less, as the following data will show :—

Steel tube 8·7 centimetres calibre	Martin steel	990 Austrian florins.
		1,145 „
Steel-bronze tube of same calibre		350 „

The workshops in the Arsenal at Vienna, in the course of a twelvemonth, working at the ordinary average of fourteen hours per diem, could turn out—

Steel tubes of above size, finished	150
Steel-bronze tubes „ „	1,200

TABLE SHOWING THE RESULTS OF TESTS WITH THE DIFFERENT MATERIALS FOR THE MANUFACTURE OF ORDNANCE.

Load in Kilogrammes, per one Square Centimetre of Section.	Cast-iron frame, 9-inch gun.		Bronze. Common, from 8-pounder.		Bronze. Chilled. Cast.		Bronze. Chilled. Rolled.		Wrought iron from Styria in rods of small section.		Krupp steel from 6-pounder.		Steel-bronze near the Bore.		Steel-bronze near the Outside.	
	Elastic.	Permanent.	Elastic.	Permanent.	Elastic.	Permanent.	Elastic.	Permanent.	Elastic.	Permanent.	Elastic.	Permanent.	Elastic.	Permanent.	Elastic.	Permanent.
100	2	0	10	0	8	0	2	0	4	0	1	0	3	0	3	0
200	10	0	15	0	15	0	7	0	9	0	3	0	5	0	14	0
300	15	0	25	0	25	0	10	0	11	0	7	0	8	0	25	0
400	22	0	35	0	40	0	22	0	14	0	12	0	14	0	35	0
500	27	0	47	1	53	2	37	0	18	0	16	0	20	0	55	0
600	33	0	56	4	62	4	50	0	22	0	20	0	26	0	65	0
700	38	2	66	7	70	6	60	0	24	0	25	0	33	0	78	0
800	47	4	77	11	79	8	73	0	27	0	30	0	40	0	86	3
900	54	5	88	20	87	10	86	0	31	0	34	0	48	0	93	7
1,000	61	6	101	32	100	13	96	0	35	0	39	3	54	0	103	12
1,100	68	8	110	52	108	22	107	0	37	0	44	5	60	0	112	18
1,200	76	10	120	96	115	47	117	0	40	2	50	7	66	0	129	26
1,300	84	14	—	—	130	117	128	0	42	3	55	10	73	0	135	45
1,400	92	19	—	—	150	327	139	0	45	4	60	14	80	0	160	125
1,500	101	24	—	—	170	380	149	0	48	5	65	20	88	0	—	—
1,600	110	30	—	—	192	441	159	0	52	6	71	31	95	0	—	—
1,700	120	35	—	—	—	—	170	0	57	7	76	38	102	0	—	—
1,800	130	50	—	—	—	—	179	2	62	8	81	48	110	0	—	—
1,900	142	65	—	—	—	—	193	5	67	8	85	120	115	2	—	—
2,000	157	81	—	—	—	—	203	8	72	9	90	252	121	3	—	—
2,100	—	—	—	—	—	—	215	10	77	10	98	360	127	5	—	—
2,200	—	—	—	—	—	—	222	12	82	12	110	586	134	7	—	—
2,300	—	—	—	—	—	—	239	14	88	14	—	—	142	8	—	—
2,400	—	—	—	—	—	—	252	18	93	16	—	—	152	10	—	—
Absolute strength	2420		2260		3050		5066		4700		4800		4875		3300	
Limit of elasticity	600		400		400		1700		1100		900		1800		700	
Elongation in per cent. of original length. At the limit of elasticity	0·033		0·035		0·040		0·170		0·037		0·034		0·110		0·075	
Elongation in per cent. of original length. At rupture	0·40		15·0		40·0		2·1		22·0		21·4		2·5		40·0	
Section at point of rupture	0·96		0·66		0·54		0·96		0·62		0·50		0·96		0·58	
Hardness (length of chisel-cut)	10·2		12·5		12·5		10·2		10·5		10·5		10·5		12·0	
Number of blows of 1·2 kilogrammetres required to break a test-bar with a sectional area of ·5 square centimetres	1		1·10		—		—		—		209		255		146	

Revue d'Artillerie (Paris), Jan. 1875.

In a subsequent communication to the undernamed journal, General von Uchatius gives the annexed details of the first experimental gun manufactured on this principle. The gun was fired 1,800 times with the full service charge, without the least alteration being perceptible in its dimensions and general appearance, or in its shooting powers.

He also gives the table inserted on the opposite page, showing that the same constructive principle is applicable to steel guns. A solid gun of best white Neuberg steel thus heated would be stronger than a coiled steel gun, perhaps as good as a steel-bronze one.

But in all comparisons of coiled and cored guns, we must

Steel-bronze experimental gun.	Bore.	Outside.
Absolute strength in kilog. per sq. centim.	4250	3320
Elastic limit per sq. centimetre: permanent in kilog.	1100	500
Elastic limit per sq. centimetre: per blow in kilog.	0·386	0·184
Elongation at rupture, per cent. of length	16·5	50
Elongation at limit of elasticity „	0·306	0·060
Section at point of rupture	0·56	0·50
Hardness (length of chisel-cut)	10·6	12·0
Number of blows of 1·2 kilogrammetres required to break a test-bar with a sectional area of ·5 square centimetre	220	116

TABLE SHOWING THE RESULTS OF TESTS WITH DIFFERENT DESCRIPTIONS OF STEEL.

Quality of Steel.	Absolute strength in kilogrammes per square centimetre.		Elastic limit in kilogrammes per square centimetre.		Elongation in per cent. of length.				Hardness (length of chisel-cut in millimetres).
					At rupture.		At the limit of elasticity.		
Test-bar of Krupp's steel, 75 mm. long, with a sectional area of ·5 square centimetre	4800		900		21·5		0·034		10·5
Similar test-bar after exposure to a strain of 50 kilog. producing an elongation of 1·6 per cent.	4800		2000		20		0·160		—
Ring of the same steel compressed with 2 pistons: Diameter. Inner. Outer.									
Before pressure . . 239·5 171·1	4800		900		21·5		0·034		—
After pressure . . . 240·7 172·9	5666		2000		14		0·110		—
Cylinder of very soft Neuberg steel, compressed with 7 pistons: Diameter. Inner. Outer.	Outer.	Inner.	Outer.	Inner.	Outer.	Inner.	Outer.	Inner.	In the bore.
Before pressure . . . 252·4 78·4	4200		700		26		0·025		11·3
After pressure . . . 252·6 82·0	4900	6420	1000	2000	25·3	15	0·111	0·143	10·6
Cylinder of Neuberg steel of medium hardness, compressed with 1 piston: Diameter. Outer. Inner.									
Before pressure . . 252·50 80	5140	6400	600	1200	18	16	0·030	0·189	9·7
After pressure . . 252·75 80·75	5200	8580	800	3400	16	8	0·030	0·354	9·4

take into account the question of cost. Steel guns are at a disadvantage as compared with steel-bronze guns in the following respects:—

1. They are four times as expensive.
2. They take six or seven times as long to make.
3. They are more sensible to atmospheric influences.
4. They are more liable to burst, and therefore less suited for military purposes. *Stummer's Ingenieur, 22nd Jan.* 1875.

IMPROVED DOVETAILING MACHINE.

IN briefly summing up the capabilities of this device, we may state that it cuts to lengths and squares and dovetails both ends of the boards operated upon, at once, requiring them to be passed through but a single time. It can be changed for different length of stock while running, as easily as the guide on a saw bench. The dovetailing is accomplished on any bevel, angle, or flare, with great accuracy, and a rabbet or groove is also cut for an inside corner. It is claimed that the machine will prepare boards so as to make from 600 to 1,000 cheap boxes per day of ten hours, doing its work in cross-grained or knotty lumber as well as upon clear stuff, and with very little more expenditure of time. It is well adapted for casket and coffin work, ornamental box work, and for the manufacture of trays, hoppers, mouldings, picture frames, cornices, patterns, and, in short, of all flared and many-sided objects.

Referring to our illustration, fig. 1 (see next page), at A are feet which serve to hold the board to be operated upon firmly in place. These are connected with levers which pass through standards, and the play of which is regulated by the set screws, B. In order to raise or lower the feet, so as to place or release a board, the outer lever arms are connected with a cam bar, C, to which a handle is secured. By carrying the latter from a vertical to a horizontal position, the bar, C, is turned, thus raising the lever arms, and so forcing the feet firmly down upon the work.

The board rests upon travelling ways, one of which, D, moves upon the outer portion of the frame of the machine. The other moves upon the frame, E, which is arranged upon a support having a motion transverse to the apparatus, so that the ways may be adjusted to suit varying lengths of boards to be cut. This adjustment is effected by means of a horizontal rack connected to the moving frame, in the teeth of which engages a pinion rotated by the crank, F. Upon the bar of the frame, to which the pinion is secured, is marked a suitable index, by means of which accurate adjustments may be made. The cutters and tools upon the moving frame are actuated by the pulley, P, which is arranged to slide freely along while revolving with its shaft.

The board being placed as we have described, is carried over the machine in the direction from left to right in the engraving; and during its passage both of its ends encounter certain cutters and saws, which form it in the shape represented in the portion X, shown to the left, on the floor. To understand this operation, it is necessary to consider the action upon each end separately, and therefore we will begin with the upper extremity of the board, as represented beside the machine. This, it will be observed, has the male portion of the dovetail, which, when being cut, rests upon the travelling piece on the frame, E. As the stuff is carried along, it is first met by the cutter, G, which forms

Fig.2

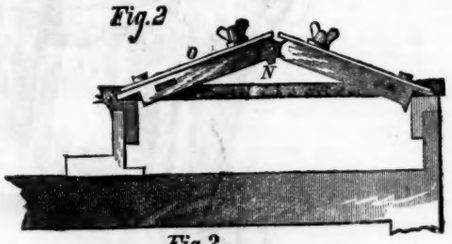
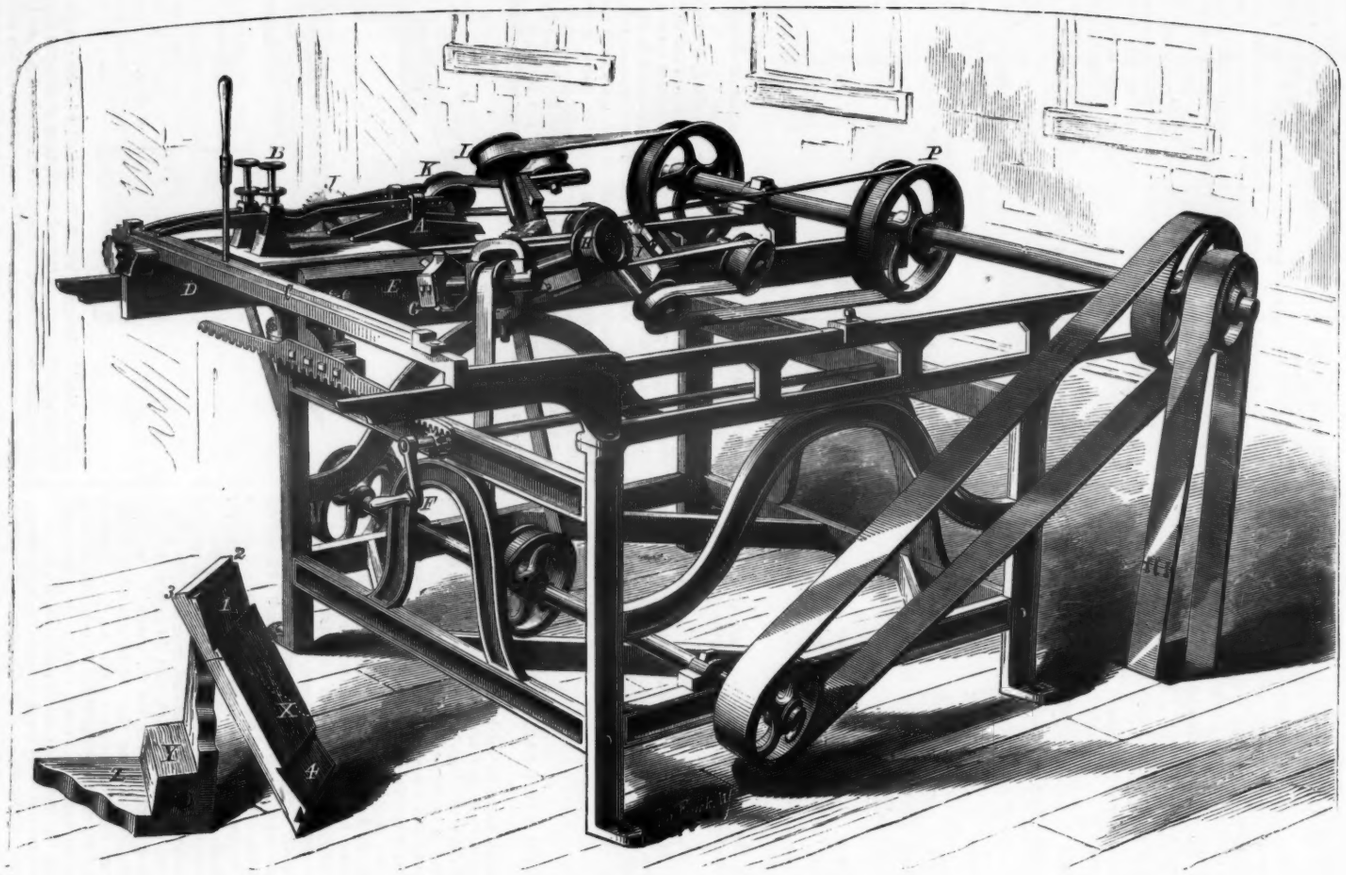


Fig.3

half the inside dovetail, which is marked 1 in the sample piece X. A second cutter on the arbor, H, then makes the lower half of the male dovetail of the mitre joint, marked 2. At I, a saw and cutter are so arranged that the former cuts off the board and thus determines the length of the male portion of the dovetail, while the latter, a thick tool, forms the other re-entering portion, 3, thus finishing the end.

The other extremity of the board is first met, as before, by a cutter similar to G, which makes the other half of the inside dovetail, 4, then by a saw, J, which cuts the end to the proper mitre. A tool at K next forms the upper half of the female dovetail, and another saw, at L, finishes by making the lower half of the same. If now the piece, X, be cut diagonally in two



IMPROVED DOVETAILING MACHINE.—Fig. 1.

in the direction of the spiral dotted line, and its dovetailed ends fitted together, a third piece, Y, slipped into the inside dovetail, formed by 1 and 4, completes the joint, which appears as in the second sample piece, Z.

All the various heads belonging to the cutters which we have described are arranged with set screws, so as to be adjustable to cut the dovetails deeper or wider, and in order to compensate for wear.

In figs. 2 and 3 is shown an attachment for guiding boards at suitable inclinations to the saws, so as to be mitred to any desired angle. This consists in a table, N, hinged in the middle, the angle formed by the parts of which becomes greater or less as the movable way is carried further from or nearer to the stationary one. The board laid upon the inclined surface is presented to the tool at the angle to which the table is adjusted. In order to cut the edge for flaring work, such as hoppers, caskets, &c., after the table, N, is placed in position, the location of the board may be altered so that the mitre is made diagonally instead of straight along the end, by resting the piece against a guide, O, fig. 3, which is locked in place by a set screw, which passes through a slot in the table.

The machine represented is claimed to be well adapted for the joinery of flasks, ordnance boxes, feet for furniture, and ice chests. *Scientific American.*

THE CLEANSING OF REFUSE MANUFACTURING WATER IN GERMANY.

WHILST pending the solution of the sewage problem, and at a time when all our sanitary engineers are engaged with the question on the pollution of rivers, a few remarks on the methods adopted by our continental neighbours in treating refuse waters will, we think, be of interest.

The disinfection of the refuse water, as practised in many parts of Germany, will first engage our attention. The clarification of such waters in general is conducted in a similar manner to the method adopted here; large pits or reservoirs of a rectangular form, with inlet and outlet on opposite sides, may mostly be seen working for this purpose. There, as in this country, the facts seem to be overlooked, or rather underestimated, that the decomposition of the organic matter contained in these liquids is greatly hastened where large sheets of stagnant waters are presented, and that this process of decomposition increases in its rapidity of action with the temperature of these refuse waters. It is true that, as the outlet is brought opposite the inlet, a current may in some cases ensue, but so much is certain that it is a very rare occurrence that the force of this current is sufficiently great to keep the remaining water in an agitated state, consequently, even in those instances where a current takes place, this running water must necessarily in its passage through the reservoir become mixed with the adjacent waters, and must further become impregnated with the impurities of the latter. We find, therefore, that these reservoirs, built perhaps with the best intentions and with purse-unsparing hands, ultimately become pits for the generation of carbonic acid and other deleterious gases, besides throwing out an outlet water much more offensive and impregnated with impurities than the inlet water ever was; in few words, we build to preserve, and as a result we create the very worst of destructive agents.

Passing over to the disinfecting methods adopted on the Continent, we find them grouped under two headings, namely, for cleansing refuse water merely to the extent required by the authorities, and, secondly, for not only cleansing the water to this degree, but also for rendering it fit to use again for the factory or works. The first method requires naturally less care than the second, and likewise a smaller amount of disinfectants will be required in the former than in the latter method to obtain the object desired. We may now proceed to describe the manner in which we saw one of these disinfecting powders (known by the name of Lüder and Leidloff's) applied to a sugar refinery. The refuse waters from the refinery or works were led into one narrow channel, over which was mounted a sort of wooden hopper with an adjustable opening at its lower part. Over this opening a feed arrangement was fitted, which consisted of a wheel, mounted on a shaft, passing through the hopper; outside of the latter, and fitted to the said shaft, was a driving pulley, which was driven by means of a strap from a small water-wheel, which in its turn was driven by the outflowing water in the forementioned channel. The hopper was filled from time to time with this disinfecting powder, and by this arrangement the outflowing water received a continuous quantity of the disinfectant as it fell from the hopper. To clarify the water six reservoirs were cut side by side, each 40 yards long, 2 yards wide at the surface, and only 1 yard wide at the bottom. The depth of the three first reservoirs was 5 feet, whilst the remainder were only 3 feet deep; these reservoirs were each connected with one another with inlets and outlets 3 feet wide. The circulation of the water through these reservoirs caused the water to be thoroughly purified on its arrival to the fifth basin, from whence it passed into the sixth, and could be led from thence either into an adjoining stream or back again into the factory for re-using. From the preceding description it will be seen that, in this case, no large surfaces of sheets of water were exposed to the action of the atmosphere, and that all the water was kept in an agitated state in the various reservoirs from the inlet and outlet passages being made amply large, thus preventing a stagnant state. The ground required for these reservoirs amounts, as may be easily calculated from the dimensions given, without allowing for partition-room, to 240 square yards; if pinched for ground-room, no doubt five reservoirs would suffice, although it might not be advisable to restrict oneself to too close a limit.

With regard to the costly quantity required of the disinfectant, it varies, of course, according to the object the manufacturer has in view with regard to the refuse-water; if he merely wishes to cleanse this liquid to the degree ordered by the German police (Sanitätspolizei), the following quantities have been found to suffice per thousand cubic feet of liquid:—

	lbs.		lbs.
Waters emitted by the condensation process	5·5	to	6·6
Waters thrown off by the presses, or cleansing of the beet-root	8·8	to	11·0
Spodium waters of all kinds	15·4	to	17·6

If, on the other hand, these refuse-waters are to be used up again for the refineries or works, the forementioned quantities will have to be doubled to meet this requirement in a satisfactory manner. The cost of the disinfecting powder is about 4*s.* per cwt.; and for a sugar refinery consuming 50 to 60 tons of beet-root per day, it is computed that from eight to nine shillings' worth of this powder will be daily expended where the water is sent back to the refinery. We have gone into the details of this method, since, judging from the opinion expressed at a recent meeting of the principal beet-root sugar manufacturers of Silesia, it received a very favourable judgment, from which may be inferred that it is thought to be the best yet introduced in Germany.

From the preceding remarks we may form an opinion as to the degree of perfection our neighbours have reached in the cleansing of their refuse-waters from sugar-refineries. Although this disinfectant may suit their purpose very well, still the ugly fact remains, that where one pound of this powder might suffice for purifying a certain quantity of water at a ***high*** temperature, three times that quantity has been required to clarify the same quantity of waste water when cold; it is owing to this that all the streams of waste water are, as we have already remarked, led from the works to one channel, in order that the colder streams may be warmed or raised in their temperature by the warmer ones. Again, as the powder is only mixed with the refuse-waters after their juncture with each other, so the action of the disinfectant is rendered more efficacious than if the powder was applied to the liquid when cold. Without further commenting on the efficacy of these disinfecting powders, we think we may derive one lesson in the apportioning of the superficial area of such reservoir from the practice there adopted.

In the Rhine provinces, especially in the neighbourhood of Aix-la-Chapelle and Verviers, the refuse-waters from the woollen mills are treated in two different ways. The first process, which may be called the "acid treatment," is, on account of its greater simplicity, more extensively practised than the second process. In the first, the utilization of the waste waters is not carried on by the millowners themselves, but is left in the hands of chandlers, to be carried out at their own works. The refuse-waters are collected into wooden casks at the mills, and sulphuric acid is added for the sake of decomposing the waters; as a result, a black, oily mass, containing dirty woollen fibres, is formed, which is sold to these chandlers, whilst the remaining black liquid is allowed to escape into the river or outlet-channel. This mass is first pressed; it is then put into iron vessels over a fire, and distilled by means of superheated steam; the products of distillation are oleic acid, and various other fatty acid compounds. The former is separated from the latter by first applying a cold pressing, and subsequently pressing these hot, when the fatty acid compounds can be directly used for candle-making.

The second process, above referred to, is based on the insolubility of lime-soap, and in the decomposition of soapy waters by

means of chloride of calcium. The first difficulty of this process was in duly separating the lime-soap from the liquid, and in converting the then liquid soap into a dry saleable article. We will give a description of the manner in which this is effected at Mr. Schwamborn's mills at Aix-la-Chapelle, who is the first party that has carried out this process satisfactorily, and with remunerative results. The fulling waters are directed into a reservoir of about 250 cubic yards capacity, which is filled every fortnight on an average. From this pit the waters run into an equally capacious second basin, situated somewhat lower than the first, a quantity of lime-wash is added to these waters as they enter the second reservoir, the current helping at the same time to mix the two thoroughly together. This reservoir is fitted with a false bottom, being lined with three courses of brickwork, the lowest lying on its broad side, the second on its narrow side, and the last lying again on its flat side; the bricks of the two lower courses are merely laid side by side, whilst the top layer is set in mortar. At one end of this reservoir we find a partition with holes which are at first closed up with wooden corks, and then opened from the top downwards, as the lime-soap is formed, and falls to the bottom of the pit, leaving the supernatant fluid now cleared of its impurities to escape through the passages of the partition into the river or outflowing channel.

The effect of the limewash on these fulling waters is so rapid, that two hours after the mixing has taken place clear water may be tapped from the second reservoir. After a few days' standing a solid mass will have formed itself on the false or upper bottom of this pit, and as the mass dries, so it begins to crack (similarly to clay), allowing any liquid that may have remained to trickle through these fissures and to be absorbed by the proper bottom. This mass, which is the lime-soap, is afterwards removed and placed under cover to dry more effectually. The selling price of this soap at Aix-la-Chapelle is about 9*s.* per cwt. where it is bought by private gas companies. Mixed with coals it produces a capital gas, which requires very little cleansing, as the following experiments will prove.

This lime-soap may be gasified in the usual manner in which mineral oils are gasified, or may for this purpose be mixed up with coals and thus used in the ordinary gas-works; if treated as a mineral oil it has the advantage of requiring less space for generating purposes.

In order to determine the luminosity of the gas so produced a series of experiments were conducted in the following manner: The materials used were gaseous coals, fatty matters received from the wool-washings or acid treatment, stearine-tar and lime-soap. The materials were previously weighed, and the quantity of gas thrown off by these were subsequently measured by a gas-meter. Lastly, the illuminating power was determined in a dark chamber by means of a Bunsen's photometer. The gas was burnt by a split gas burner (4 cubic ft.), and the results obtained were in comparison to the parliamentary English candle.

For the first series of experiments the gas was obtained by mixing 106·5 lbs. of lime-soap with 644·5 lbs. of coals, and this amount threw off on an average 80 cubic metres of gas. The luminosity of the gas so derived was very irregular; at the beginning, with a consumption of 2·5 cubic ft. of gas per hour, an illuminating power equal to $25\frac{1}{6}$ candle-light was obtained, but the latter gradually sank, and after three hours' observation the power had been reduced to $14\frac{1}{3}$ candles.

Subsequent experiments conducted without mixing the products showed the following results:—

Raw-products.	Weight.	Gas so obtained in cub. metres.	Comparison of gas quantities, taking coal gas as unit.	Luminosity per hour per 2½ cubic ft. per split burner (4 cubic ft.) in the parliamentary candle.	Comparison of luminosity, taken that of coal gas = 1
Coal . . .	751	71·5	1.0	9.0	1.0
Woollen fatty matter	168	16.0	1.03	27.5	3.06
Stearine-tar . .	168	15.0	0.90	29.3	3.25
Lime-soap . .	320	49.0	1.61	32.3	3.59
The above charge .	751	80.0	1.18	...	...

In comparing these results it must be borne in mind that all these products were gasified in the large retorts that were already on the spot and used for the production of coal gas; the preceding data show that more advantageous results would have been obtained in the production had these retorts been smaller. Again, it must also be observed that the gas obtained whilst the lime-soap was being distilled showed a wonderful constant luminosity, whereas with the other compounds the illuminating power was gradually on the decrease during the time the distilling process was going on. These experiments would seem to prove that lime-soap was the natural ingredient for the generating of gas, as will appear all the more evident when we consider:

First. With equal charges, we obtain one volume of gas with coal; but 1·61 volumes of gas from the distillation of lime-soap.

Secondly. In burning equal volumes of gas, we receive for every unit of light obtained by the distillation of coals 3·59 luminar units by the use of lime-soap.

Thirdly. With equal charges of the raw ingredients, we receive for the luminar unit of coal-gas, 5·78 luminar units of gas from the distillation of lime soap.

Fourthly. As 1 cwt. of lime-soap furnishes as much light as 5·78 cwt. of coals would do, and as the distillation of the former is more easily effected than the latter, it is evident that, in order to obtain equal luminosity, it will take about six times as much fuel to obtain such gas from coals, in comparison to the lime-soap method.

Fifthly. Again, only one-sixth of the time will be required for distilling the lime-soap, as compared with coal-gas, which must necessarily not only effect in a corresponding degree a saving of fuel and workmen's wages, but must also impart greater durability to the gas retorts.

Sixthly. As 751 lbs. of coal produces 71·5 cubic metres of gas, 100 lbs. would produce 9·5 cubic metres; similarly 100 lbs. of lime-soap would produce 15·3 cubic metres of gas; but as the luminosity of lime-soap gas is 5·78 times greater than coal-gas, we may write the proportion

$$\frac{\text{lime-soap gas}}{\text{coal-gas}} = \frac{15{\cdot}3}{(9{\cdot}5 \times 5{\cdot}78)} = \frac{15{\cdot}3}{54{\cdot}9} = \frac{1}{3{\cdot}59}$$

that is to say, in using lime-soap gas, about $3\frac{5}{8}$ less volumes of gas have to be distilled in comparison to coal gas.

Seventhly. For the preceding reason, the distillation of gas from lime-soap may be carried out in smaller vessels, thus effecting a further saving in the outlay.

We have just enumerated the advantages which the distillation of lime-soap may be said to possess over coal-gas; but it must not be forgotten that, in the latter process, a valuable residue in the form of coke is left, which is not the case with lime-soap. Nevertheless observations have shown that the more rapid distillation of the latter fully compensates this deficiency in even a profitable manner.

We now come to the question, which of these two processes pays best, and considering the two, from the results obtained from large practical trials, and the constructions required by each of these methods, we must decidedly give preference to the last described process.

According to the practical experience of those who have adopted the "acid treatment" to obtain the separation of the oily acids, a large quantity of sulphuric acid is required; and again this process is rendered more costly by the application of superheated steam. A small proportion of the organic matter held in suspension is only removed, and such substances as printing colours, metal salts, &c., remain in the thin liquids. The application of this process is, nevertheless, not without emolument, inasmuch as at the Bockmühl Mills, Düsseldorf, a yearly nett profit of £120 to £150 is derived from this process.

Simpler and more profitable is the second, or lime process, which fulfils its work in a far more satisfactory manner. Without entailing heavy expenses, the dirty refuse-waters are converted into a valuable product, and clearness is restored to the liquids no longer subject to decomposition or to the generating of noxious gases. Taking the costs of production into account, 30 per cent. of the value of the soap used is regained at the beforementioned works of Mr. Schwamborn. This fact is sufficient in itself to recommend the universal adoption of this second process. The dimensions of the reservoirs may be made smaller by emptying these out oftener, and in such mills in which the wool is also washed and dyed, the various refuse-waters may be conducted into one stream, to be there precipitated by the addition of lime, without rendering the process more difficult or taking up more time.

SANITATION—WHAT IS TO BE PRACTICALLY DONE IN CONNECTION WITH IT.

No. I.

SOME, no doubt many, of our elder readers will remember the story told of the naval captain who—to use the nautical phrase, was a "good hand at the lingo"—having occasion once to tie a nigger up for lashes for some offence which he had committed, began the ceremony or process with a neat little speech in his own style. The "nigger,"

with bare back, and shivering with cold, and by no means liking the continued exposure and torture of suspense, ventured upon this expostulation with the "king of the quarter-deck:" "If you floggee, floggee, if you talkee, talkee; but no both talkee and floggee too for poor Sambo." Many of the stages through which the Sanitary question has passed remind us of this, and we regret to say that another stage through which it is about again to pass still more forcibly reminds us of it, and the good practical lesson which it conveys. Once more the Parliament—true to its name—is again to have a talk about the Sanitary question, as if—oh powers of palaver and procrastination!—there had not been enough talking upon it already. Paper and platform platitudes have abounded *ad nauseam*, and we, as a result, are but very little nearer to—nay, if recent reports are to be credited—perhaps a little further off from the point of practically dealing with the evils which are met with everywhere and are always arising from the defective condition of the houses of our cities, towns, villages, nay the smallest of our hamlets, if not the most isolated of our cottages, and of getting at once and for all time rid of them.

It is to be hoped that not very much time will be lost in the legislature this session in discussing the measure or measures which will be brought forward in connection with this all-important subject. It cannot be hoped that no time will be lost, for the talkers will have their "talkee-talkee." But in the midst of the talk surely no time will be thrown away in discussing what are the evils connected with the system; we are all surely but too well acquainted with these, and if not it says marvellously little indeed for the powers of the press and the platform, the papers, pamphlets, books, and brochures which have been sent out, poured forth, and distributed in every conceivable way during the last thirty years, giving or professing to give the public the fullest details of a subject as sickening as it is disgraceful to us as a nation.

We shall therefore not follow the example of those who would again begin to enter into details as to the evils arising from defective sanitary arrangements; what we propose to do—and it is in strict keeping with the title and the scope of our magazine—is to show in fashion brief as possible, how those evils should or may be done away with, for there are, of course, several ways of doing the same thing. The evils are really so numerous that the details connected with the doing away with them assume no small proportion, and it is obvious, therefore, that our remarks will and must be of a somewhat general character, and indeed confined to but a few of them; but these will be the leading details, and what we give will at all events be practical, and have throughout a practical tendency. The time for talk, or its equivalent in print, with us, at least, is done; that for work alone shall engross our attention.

With a subject so wide and varied in its general details and with its special ones so numerous, and all of them important, it is difficult to know which of them to take up first, in considering the practical application of the principles of sanitation to the arrangement and the construction of dwelling-houses. But upon the whole it is a moderately safe, if it be not altogether the only true rule, to begin at the beginning. And acting upon this, as the first part of a house is the foundation, let us see what can be briefly said as to what ought to be done in connection with this. The foundation of a house is, a workman graphically said, "everything," and truly he was not far wrong; for unless that be sound the superstructure, however good, will not be safe; and this saying of the workman is specially true in the sanitary aspects of the question. Indeed it may be said that some of the most grave sanitary evils—if these two words be not indeed contradictory, as a good thing, which sanitary is, cannot be evil—arise from defective foundations. Let us see how this may be and is. The foundation may be said to consist of two things, the soil or ground upon which the building stands, and the foundation in the constructive sense, which is popularly understood to be the foundation proper. The soil on which the house is to stand is generally natural, or, as it often is, partly natural and partly or wholly artificial, the latter being what is known as "made soil;" a source of many evils, as we shall presently see.

Of the many causes which render houses so unhealthy, there is perhaps none which is so certain in its effects, and yet so difficult to be dealt with, and withal so insidious in its forms of attack and methods or ways of development, as damp. And from these peculiarities, especially that referred to as being so insidious, it is one which should be most carefully guarded against, all the more that its effects are not immediate and so calculated to strike the inhabitants or their medical advisers as others—as, for example, the evils arising from defective drainage, this making itself known by at least one of the most potent of the senses—that of smell. Damp, unless it be of so decidedly bad and highly developed a character as to show itself in its usual and melancholy signs upon the walls, gives, on the contrary, no indication of its presence in this way; it works, but works in many cases unobserved, silently—if the phrase may be allowed—doing its mischief, and this unknown to those subjected to it. Now while damp may, and often does, arise from defectively constructed walls, either too thin, or if thick, too carelessly put together, it much more frequently owes its existence to the foundations of the house having been neglected, using the term in the sense in which we have already defined it. In nine cases out of ten no attention, or if any, very little, is paid to the condition in which the soil is, and as to what the character of the soil itself is. It may be of a close, retentive clay, catching up and retaining, with the closest of grips, the drainage-water of the surface, or that coming from the surrounding and higher placed soil. A site of this kind is the very worst which can be had, and if possible another should be chosen. But if the matter is a case of "Hobson's choice, this or none," every means should be taken to lessen, and if possible do away with, its evils, for unless this be done, there will be little chance of the house being a truly healthy one. The first thing to be done is to thoroughly cross-drain the site, and indeed, the land for some distance beyond it. Let it be remembered that the drains used are field-drains, with open joints, through which the water finds its way, percolating from the adjacent soil to the interior of the tubes; these again joining with the main tube of a larger diameter, and which lead finally to the main drain or outfall. Sewage tubes are quite distinct from field ones, and are laid upon a different principle, the joints being water-tight, so as to keep the sewage in and allow of no contact with the soil surrounding them. The site should be surrounded with drain tubes, to catch or arrest the water coming in from around it; but if the expense be objected to, it is at all events essential that the side or sides towards the highest land be so provided with a catch-water drain. The actual site itself, and for a little space beyond it, should be crossed in the direction of the fall or inclination of the land by the drains, placed at distances more or less great, according to the retentiveness of the soil, the maximum distance being, on an average, twenty feet. The great mistake in draining sites when they have—which we regret to say is but seldom—to be drained at all, is that the drains are too far apart, and far too shallow or too near the surface. The latter arises from the mistaken idea that a deep drain will not draw, as it is called, the water away from the soil; but the fact is, that the deeper the drain, consistent with the limit which difficulty of working and expense will put, the better drained the soil will be. To prevent the drain tubes from getting out of repair—this arising chiefly from their getting out of line with each other—it will be the better plan to use a "collar," this being a short length of tube of diameter large enough to embrace the two drain tubes. The drain tubes themselves should not be put down too small in internal diameter, as they are apt to get silted up with the finer particles of the soil. A diameter of two inches we would place as the minimum.

Some soils are so happily adapted for good sites, such as a free gravel with sandy bottom, that no drainage seems requisite; but as even in the best soils there may be cavities or holes or "faults" in which water lodges, we should strongly recommend even these to be drained, for water lodging as it will lodge in any place under or near the site, will in time send up vapour or emanations which are much better absent than present. Prevention any day is better than cure. Of course in fine dry soils the drains will require to be fewer in number and not so deep as in the case of those which are of retentive character. In concluding our remarks upon this part of the subject, let its value be understood from this, that there would be fewer damp houses and less of the many mysterious complaints which owe their origin to them, if the sites were always drained. Amongst the soils which are to be classed as bad—and the soils of sites range from gravel as the best down to close retentive "bird-limey clay" as the worst—are what are termed made soils, to be met with on those unlucky—for the inhabitants of the houses afterwards built upon them—plots, on which is stuck up a board, "Rubbish may be shot here." Rubbish in the worst sense it is, and the shooting we would be inclined to reserve for those who permit its lodgment with the view of forming the site or foundation of houses with it, for assuredly in one sense they commit murder. It is difficult to over-estimate the evils arising from sites of made soil of this character. Some which have been examined by competent authorities have been found to consist or be made up of not merely soil, broken bricks, lime, &c., which are in one sense not bad, but also of vegetable matter, and what is far worse, animal refuse of all kinds, both of which, vegetable and animal, are liable to decay. Now, this decay gives rise to several classes of evils. First, the decay allows of the subsidence of the soil, or rather compels it to subside at the points at which the decaying matter rested, so that the danger of unequal settlements in the foundations of the house comes into play, causing the walls to settle unequally, and making ceilings to

crack, and all the other evils too well known to householders. Secondly, and what is worse, during the period in which the vegetable substances and animal refuse are decaying, they emit and send up through the soil foul gaseous emanations, the only outlet in too many cases for which is through the apartments of the house, and the presence of which is indicated by smells the origin of which not being known, or in the majority of cases not even being suspected, are set down in that category known as "most unaccountable" or "most mysterious," which covers many an evil, and allows those under their influence quietly to submit to them, there being apparently no remedy for them. Again, when once completely decayed, if the soil above does not settle down—and settle something else also which should not be so settled or rather unsettled—holes and cavities are formed, into which water or moisture collects, and this again sends forth emanations—none the better for being mixed with the last remains of the decayed substances—which have their only outlet or escape as before through the house, and also cause the soil to become damp, and through this the foundations and walls. And thus the evils go on. But further still, the rubbish is "shot" upon surfaces of the natural soil which have been in no way prepared to receive it; "shot down" upon "hills and hollows" with a supreme indifference to after results; and "shot down" often upon heaps of filth and garbage of all kinds which have been accumulating for a long time upon plots of waste and neglected land. Taking all these things into consideration—and we have in no way dealt in exaggeration either of cause or effect—need we wonder that houses built upon sites the soil of which is in these conditions named, are unhealthy, cannot possibly be healthy places for people to live in, especially for women and children, who as a rule live there the whole day, and who also as a rule are more liable to attacks of disease than the male inhabitants, who moreover are not subjected for such long periods to the causes, as they have usually to be absent on their business affairs during the greater part of the day.

What, then, is to be done in cases such as these we have so very briefly detailed? why, by no means a difficult thing; but nothing, we venture to say, will be done till the employers of labour insist upon what is necessary to be done, being done. It is not that the working details of sanitation are difficult, or so very difficult to be carried out; that they are not so, it is simply the indifference of the parties interested as to their being so. Either indifference or ignorance, and it is only when these shall be overcome that we shall see a new state of matters introduced. We, of course, are here meant to be understood as attributing the indifference to the employer of labour, who knows what should be done, but who does not care to see that it is done—the ignorance we attribute to the large body of the people generally. For it is a very curious, and not the least suggestive point in connection with the history of the science of sanitation, that notwithstanding all the talk, the papers and pamphlets, and the work generally of the press, which has been done and issued, there is still on the part of the people generally a vast deal of ignorance existing upon the subject. There is no doubt a species of vague misty understanding amongst many, that there are such things called sanitary evils, which do affect their health, and which in some kind of way are concerned with their houses; but what these evils are, and how they are connected with their homes, they have no practical idea whatever, and, of course, none as to how they are to be remedied, or how if their houses are bad, they are to be made good. If the legislature were to expend some few thousands of pounds in spreading broadcast over the country a few facts connected with the subject, we believe that more good would be done than by all the legislative enactments which can be made. For if the people universally knew the subject, they would, we venture to say, be determined that so far as they could prevent them such evils would no longer exist. Those about to build have a vast power with the builder if they please to exercise it, but it is not easy to exercise that of which they are ignorant, or to give orders for things to be done, or for points to be attended to, if they do not themselves know what these are.

But the indifference of those who do know is most highly to be blamed, for with them rests—has rested for a long time—a power to do good which they have failed to exercise. Take the question of site and soil, which we have but very briefly gone into; how easy, comparatively easy, would it be for an employer to see that the evils we have pointed out should be avoided. They can be avoided easily enough, true, at the cost of some time and money, but if these be valued more than the health either of themselves or of those related to them, there can be no more said—the matter is decided, the choice is made. But if health is the main object to be secured in the structure of a house—and if it is valued properly it will be so—then the matter is one of comparatively easy attainment. The party who is about to build, say a family house, can insist upon his builder or architect examining the site, and if it is necessary—both of them ought to know at once if it be so—to have it drained; the owner can order it to be so, and it will do him no harm, but some good, if he takes an occasional walk to look after the work himself, and to see that it is being done. He may not be acquainted with practical details, but he will be able, as a general rule, to know whether the work is being fairly done or not. And if he employs, as he should employ, a competent architect, he will take care to see that all the details be fully attended to. Where the site is to be a "made one," the matter in some respects is more easy to be dealt with, for it is not doubtful when real rubbish is used for this purpose. The nature of *that* no man can misunderstand who has eyes to see and a nose wherewithal to smell. Let the soil be good, and if the architect looks after the work he will see that the soil be properly put down, so that no settlement can afterwards take place, or holes and cavities be formed in which water can lodge, and as to the danger of which we have already pointed out. To conclude this department of our subject, let it again be understood that the evils created by bad sites are very great, exercise a most deleterious influence upon the health of the inhabitants, and are very easily, too easily brought into play; but that, notwithstanding, these evils can be in a comparatively easy way avoided by the exercise of a little care, and by the determination that this care be exercised by all connected with the practical details of the building.

TWO-WHEELED PORTABLE ENGINE,

CONSTRUCTED BY M. VERUZ, OF NANTES.

WE are indebted to "Stummer's Ingenieur" for the accompanying illustrations, on a scale of one-twentieth of the original, of a two-wheeled portable engine, which, on account of its lightness, portability, and cheapness should find a place where there is not work enough for the more expensive and solidly got-up portable engines of English make. Its suitability for farm work and other like purposes gained for it the highest class of award at the recent Agricultural Exhibition at Nantes.

Fig. 1 shows a longitudinal section, and fig. 2 a transverse section of the machine through the fire-box; fig. 3 is the same in ground-plan, with interior details; and fig. 4 a back elevation. The details are shown with clearness sufficient to render any

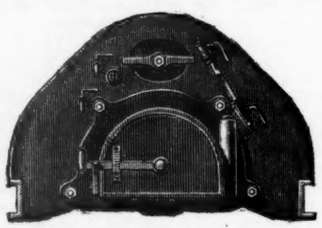


Fig. 4.

explanatory remarks unnecessary. The boiler, smoke-pipe, and chimney are of iron plate; the rest of the machine is of cast-iron, fitted in the rough, without finishing of any sort. In this way M. Veruz is enabled to turn out a locomotive of 4 horse-power for 2,000 francs, which under ordinary circumstances would cost 4,000 francs at the least.

Of course, in point of appearance, a machine of this description will not bear comparison with higher-priced articles, such as English-built locomotives; but experience has shown that its working capabilities leave nothing to be desired. The outer skin of the castings not being removed, the bearings, after a little while, acquire a polished surface presenting the hardness and smoothness of steel, and work easily, with an extraordinarily small amount of wear.

TUSSAUD'S METHOD OF TREATING FURS AND SKINS.

AN invention which gives value to what would otherwise be cast aside as worthless, may well be regarded as very useful and important, and such is the process invented and patented by Messrs. Tussaud of Baker Street, for removing furs from damaged skins, without displacing the fur or injuring its natural look, and providing it with a waterproof back-

Fig. 1.

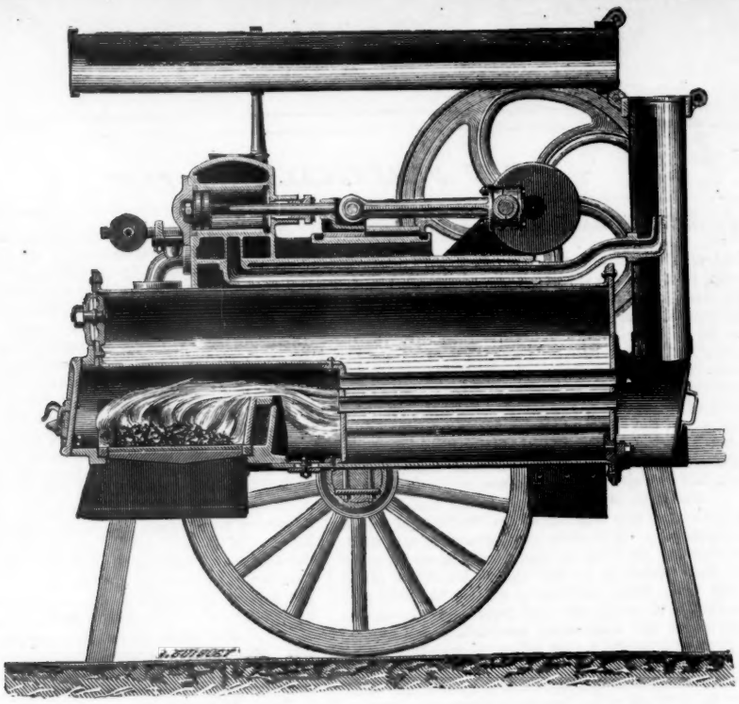


Fig. 2.

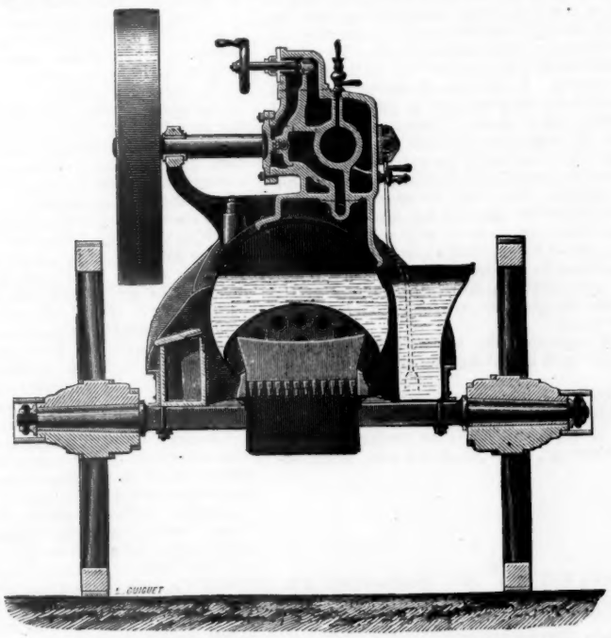
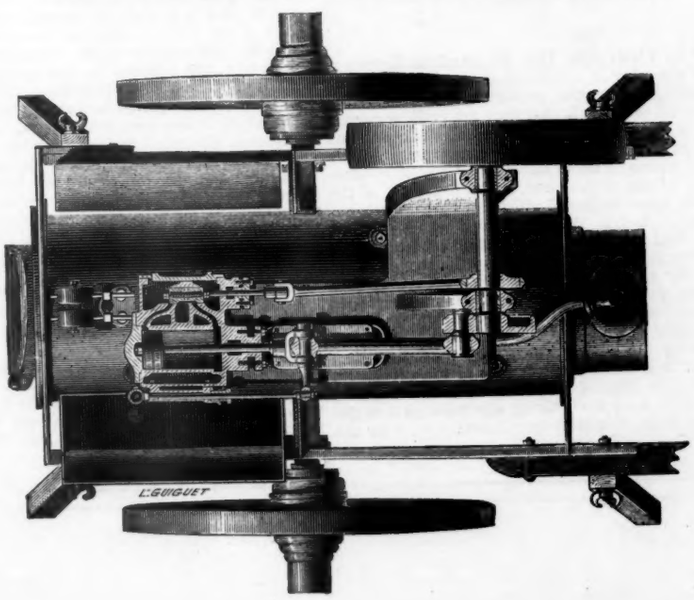


Fig. 3.



ing of calico or other flexible material in place of the decaying skin.

There are furs also of certain animals provided by nature with a strong skin, that with great advantage are treated in this manner and the skins made available for leather, thus doubling the utility of the natural product.

The first thought of this invention occurred to Mr. Joseph Tussaud while engaged in his artistic profession of modelling for the well-known exhibition in Baker Street. He states that when the eyebrows of his models were altered from time to time, during the process of recolouring, the artist sometimes changed both the expression and the likeness to the original. This was annoying, and Mr. Tussaud became anxious to discover some way of setting the eyebrows permanently. This he found to be a very delicate task, but like all inventors he was ready to grapple with difficulty. Passing by a butcher's shop he noticed that the hair upon a calf's head was very sleek, and he thought that if he could take out some of the hair and place the roots in wax without changing the relative position of each hair he would solve the problem. It then occurred to him that if he should place something on the hair, some solution to mat it together and hold it firmly, he could draw it out and pour hot wax on the roots. This experiment was completely successful, and opened the way for the greater invention that followed, which may be thus described :—

A solution of some substance which, when the solvent is evaporated, will form an artificial skin close upon the natural one, is applied to the outside of the skin, firmly matting together the feathers or hair or other covering thereof at or near the roots, so that the skin may be removed without destroying it. To render this easy, it is previously steeped for a short time in lime water, as customary among tanners. A solution of shellac in alcohol will produce the artificial skin, but glue, size, or gelatine applied in solution better answers this purpose. This can be applied either by pouring it on or immersing the skin in a bath of it. The roots of the hair are then cleansed of fatty or animal matter, and a coating of india-rubber, gutta-percha, or any other suitable adhesive substance is applied. The cloth lining is placed upon the projecting roots, and takes the place of the skin removed.

Vulcanization of the india-rubber or gutta-percha makes it more durable, and this is done by applying a solution of chloride or hyper-chloride of sulphur in bisulphuret of carbon. When the artificial skin has sufficiently hardened, the hair or fur is washed in hot water, and the glue, or temporary holding substance, removed for use again.

Mr. Francis Tussaud suggested the use of india-rubber to hold the roots, and has assisted his brother in making the invention of practical value.

This patent fur is moth and mildew proof, unlike the natural furs, which are exposed to these destructive agencies. It is very durable, and not being so thick and heavy as the natural skin, it is well adapted for trimmings, and presents a very beautiful appearance.

THE PRACTICAL NOTE-BOOK OF TECHNICAL INFORMATION USEFUL TO STUDENTS AND WORKMEN.

(96.)

How to Describe the Eccentric Curves.—In the various curves which we have given in preceding notes, the peculiarity connected with nearly all of them is that they are endless curves, that is, they continually return to each other, one half joining the other half at any point in the sweep of the curve, although these curves may not be symmetrical on each side of the central line, as in the case of the egg-shaped curve, the upper radius of which is of greater dimensions than the lower. But in the "parabola," which we now take up, we shall find that, like parallel lines, however far extended, the opposite lines will never meet, so the curves of the parabola, however far extended, do not meet or return into themselves. To describe the parabola, the focus and directrix being known. The focus is a constant point, and is placed on a line drawn perpendicular to a line which is called the "directrix" of the parabola. In fig. 542 *a* is the "focus," *b c* the "directrix." The parabola is useful in many constructions of the mechanic, &c., as in obtaining the outline of beams of steam engines, &c., &c. The curve is such that, taking any point as *d* in the curve, and dropping from this a perpendicular as *c d* to the "directrix," the perpendicular distance will always be found equal to the radial distance *d a*, or from *d* to the focus *a*. The line *a e* is the "axis of the parabola," and the point *f* its "apex," this being found by dividing *t a* into two equal parts in the point *f*, the point *t* being the intersection of the directrix *b c* with the axis *t e*. Take any number of points in the directrix, as *f' g h* (marking these off on the other side *t c* of the directrix), and from these points draw perpendiculars, as *f' i*, *g j*, *h k*. Then from the points in the directrix, as *f' g' e*, draw lines to the "focus" *a*. Next bisect these lines in *h a* in the point *l*, and from *l* draw perpendicular to *h l* the line *l p*, cutting the line *h m k* in *p*. In like manner bisect the lines *g a*, *f a*, *a b* in the points *m*, *n*, and *o*, and from these points draw perpendiculars *m q n r* and *f s*, cutting the lines *g j*, *f i*, *b s* in the points *q*, *r*, and *s*. Through *r*, *q*, *p*, and *f* draw the curve by hand. The opposite side of the curve will be quicker to draw in, taking across by horizontals, as *q u*, the points *r*, &c., to the perpendiculars in the line *e v*, corresponding to those on the other side of the axis *t e*. *Another method is shown in fig.* 543, in which the "focus" *a*, and a point as *d* in the curve, and the "directrix" *b c*, are given. Through *a*, the focus, draw the axis *t e*, and make *e f* equal to *d e*. Divide *d e* into any number of equal parts, as also *e f*, and from these draw perpendiculars, as *h l*, *i m*, *j n*, *k o*. Divide the distance *g a* (*g*, the "apex" of the parabola, being found by bisecting the distance *a t*) into the same number of equal parts as *d e* is divided into, as at the points *p*, *q*, *r*, and *s*. From the point *f*, through these points on *g e*, draw lines, as *f l*, *f m*, &c., cutting the perpendiculars *h l*, &c., in the points *l*, *m*, *n*, and *o*. Through these draw by hand the curve of the parabola, the other half may be similarly obtained, or by taking over by horizontals, as *m u*, the points *l m n o*.

To draw a Tangent Line to a Parabola.—Let *u'* (fig. 543) be the point at which the tangent is to be drawn. From *u'* draw the perpendicular, *u' v*, and make *u' v* equal to *u' a*. Bisect the angle *a u' v* by describing arcs from *a* and *v* as centres, with radii greater than half the distance *a v*, cutting in *w* and *x*; through *w x* draw a line, *w f*, which, touching the curve at *u'*, will be the tangent required.

To describe the curve known as the "HYPERBOLA" in fig. 544, of which the "axis," *d a*, the "vertex," *b*, and the "ordinate," as *e f*, are known ; *a b* is the height or "abscissa" of the parabola. Through *a* draw *c e* at right angles to the axis, *d a* ; and make *a e* equal to *a c*. From *e* draw *e g* parallel to *c f*, and draw *f g* parallel to *c e*. Divide the distances *c a*, *a e* each into the same number of equal parts as six in the diagram, and number them, as there shown ; and from the points draw to the point *d* lines as shown. Divide the ordinate, *c f*, into the same number of equal parts as *c a* is divided—six—and from the points draw to the point *b* lines as in the drawing. Where the lines 5 5 or *c a*, *c f*, cut each other, as at *h*, a series of points will be obtained, as *i*, *j*, *k* and *l*, through which the curve will be drawn by hand. The other half of the curve will be similarly obtained, or the points found on the lines drawn from divisions on *a e* to *d*, by carrying over the points, as *e i*, by horizontals, as *i m*.

Another method is shown in fig. 545. Let *d a* be the "axis," *b* the "vertex," *a b* the "height," and *c f* an "ordinate." At right angles to *a d* from *c* draw *c e*, and make *a e* equal to *a c* ; and from *c* and *e*, parallel to *a d*, draw *c f*, *e g*, and join *f g*. Divide *a e*, *a c* each into any number of equal parts, as six, in the drawing, and from the points draw lines to *d*. Divide *e g* into the same number of equal parts as *a e*—six—and from the points draw lines to the point *b* ; number the divisions in *a e*, *e g*, so that 1, 1, shall be nearest each other ; then the intersection of the line 1 *d* with the line 1 *b* will give a point *l*, which will be a point in the curve of the hyperbola. The other parts, as *k j i h*, are obtained by the intersection of the lines 2 2, 3 3, 4 4, 5 5. The other half of the curve can be similarly obtained, or by carrying over by horizontals the points *l k*, &c.

Having in the previous notes on the subject now in consideration, described various methods of describing ellipses, &c. we propose to give now, as supplementary to these same notes, and illustrations connected with these, a method of describing the curve of an ellipse by means of arcs, which gives a very near approach to the true curve (by referring to previous notes the student will find the fact explained that no ellipse can be truly described by means of *arcs of circles*). Let *a b*, fig. 546, be the major (transverse) and *c d* the minor (or conjugate) diameter or axis. Bisect the minor axis *c d* in the point *e*, and from point *e* with radius *e d* describe the semi-circle *b f c*. Bisect the distance *a f* in the point *g*, and from *j* as a centre with *g f* as radius describe the circle *h f i a*. Through points *a* and *b* parallel to *c d* draw the lines *j k*, *l m*, and parallel to *a b*, through *b* and *c*, lines cutting these in *j k l m*. Produce the minor axis *c d* on both sides of the diameter to *h* and *i*. Join *a d*, *a c*, *m e*, *l e*. Perpendicular to *a d*, *a c* from the points *j* and *k* draw lines cutting *h i*, in the points *h i*. With the distance *h e*, or

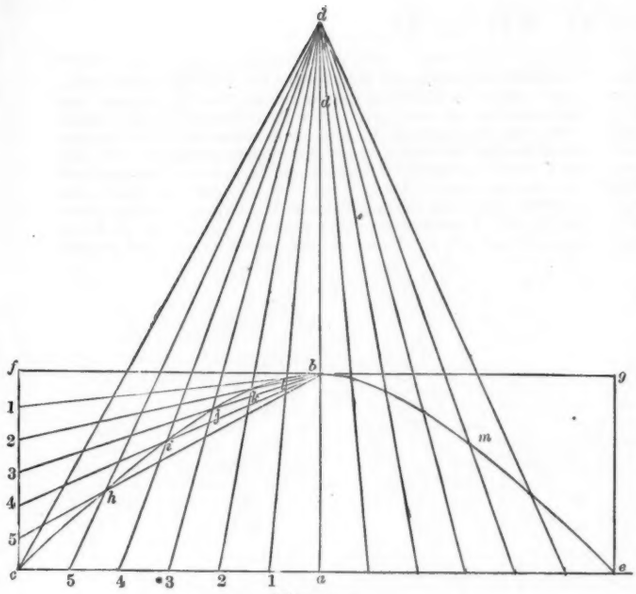


Fig. 544.

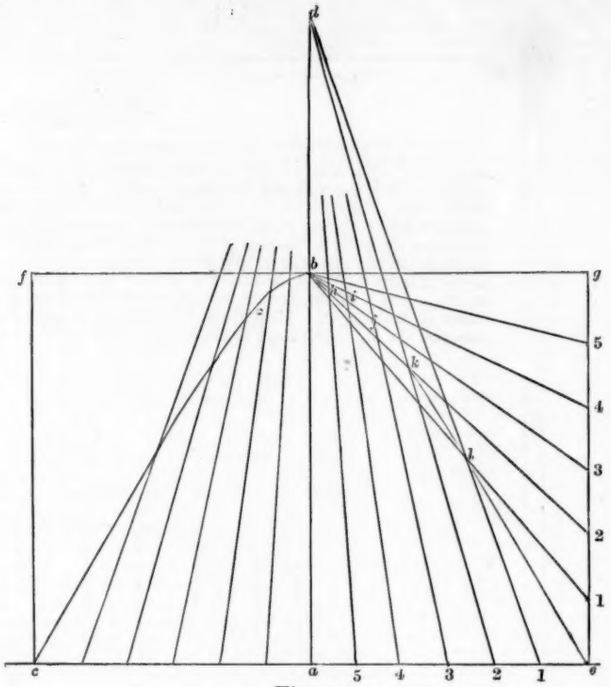


Fig. 545.

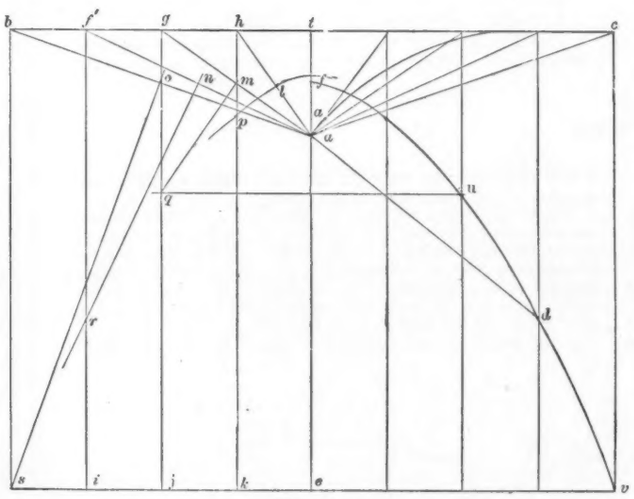


Fig. 542.

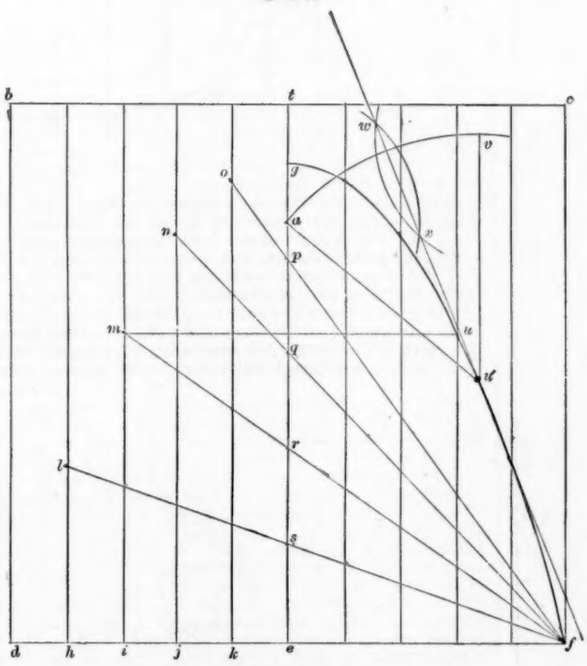


Fig. 543.

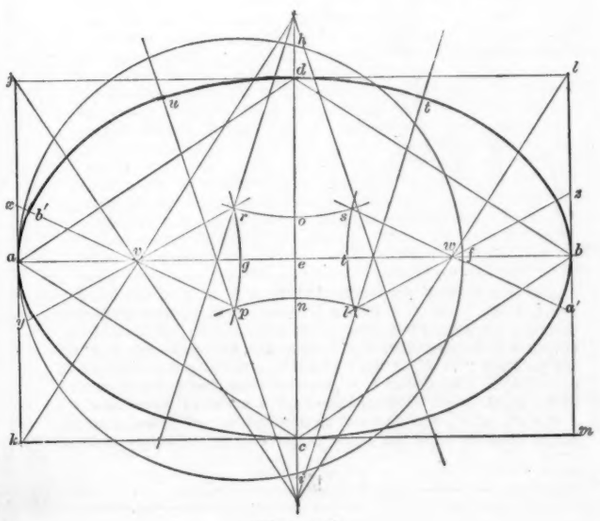


Fig. 546.

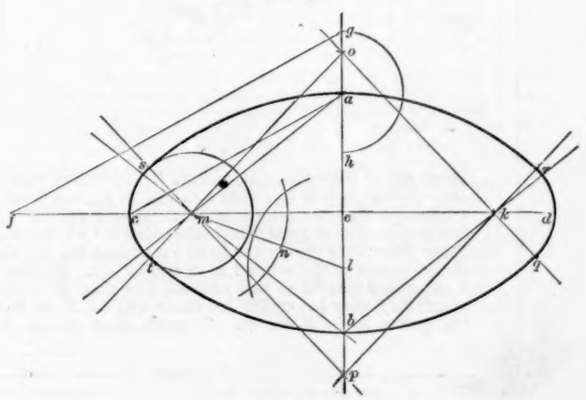


Fig. 547.

c e i, set off from points *c* and *d* to the points *n* and *o*, and from *h* and *i* as centres, with *h n* as radius, describe arcs *n p*, *o r s*. With distance *h e* or *i e* as radius and from points *a* and *b*, describe arcs *r p*, *s q*, cutting the others in the points *r p q* and *s*. From the point *i*, through *p* and *q*, draw lines *i q u*, *i q t*; through the points *v* and *w* (where the diagonals *j i*, *h k* intersect) draw from *r p*, *q s*, the lines *r y*, *p x*, *q z*, and *s a*, the points *v*, *w*, *h*, and *i* in the centres of the arcs which make up the curve of the ellipse. Then from centre *v* with radius *v a*, describe the arc which stops at the lines *v y*, *v x*. Next from centre *p* with radius *p b'* describe the arc *b' u*, and from centre *i* with radius *i u* the arc *u t*, from centre *q* the arc *t z*, and from centre *w* the arc *z a'*; one half of the ellipse will thus be put in from the three centres *d*, *r* and *s*. Another method, which has been devised by a Mr. Cross of Birmingham, is shown in fig. 547, and gives by means of arcs of circles a very near approach to the true curve. Let *a b* be the conjugate or minor, and *c d* the transverse or major axis of the ellipse, producing these to *g* and *f* indefinitely, will make *c f* equal to half the minor axis, or *e b*. Draw the diagonal line *c a*, and parallel

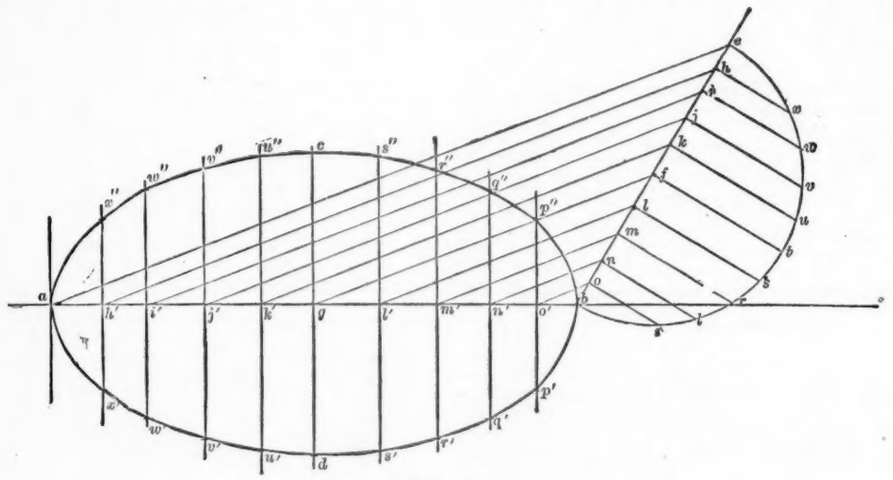


Fig. 548.

to it from *f* the line *f g*, cutting the minor axis, *b a*, produced. With the distance *g h*, set off from the points *a*, *b*, *c* and *d* to *h*, *k*, *l* and *m*. Join the parts *l m*, and bisecting it in the point *n*, draw from *n*, perpendicular to *m l*, a line cutting *b a* produced in *o*; make *e p* equal to *e o*. Through *k* and *m*, from the points *o* and *p*, draw the lines *o k q*, *p*, *k r*, *p m s*, and *o m*. The points *o*, *p*, *m* and *k* are the centres of the arcs which give the curve of the ellipse. Then from centre *m*, with *m a* as radius, describe the arc *s t*, stopping at the lines *m t*, *m s*; from centre *p*, with radius *p s*, the arc *s r*; from centre *k* with radius *k r*, the arc *r q*; and from centre *o*, with radius *o q*, the arc *q t*, which finishes the curve.

But, as the student will learn in referring to a previous "Note," the true curve of an ellipse is obtained by finding a number of points, through which to draw the curve. Of this principle we have already given several illustrations; in fig. 548 we give another founded upon the sections of a cylinder by a line oblique to its central axis, and the application of which the reader will find in the "Note" on the Development of Surfaces, &c. Let *a b*, *c d*, fig. 548, be the major and minor axes of the ellipse. From

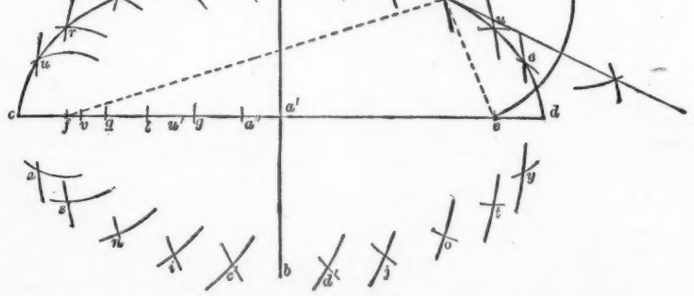


Fig. 549.

either end of the major axis, as from *b*, draw at any angle (60° in the drawing), a line *b e*, make *b f* equal to *g c*, and from *f*, as a centre, describe the semicircle *b t e*. Divide the diameter *b e* into any number of equal parts in the points *h i j k*, &c., and from these draw lines perpendicular to *b e*, cutting the periphery of the semicircle in the points *x w*, *v*, *u t*, &c. &c. Join the points *e* and *a*, and parallel to this diagonal line draw lines from the points *h i j*, near *b e*, cutting the major axis *a b* of the ellipse in the points *h' i' j' k'*, &c. &c. Through these points, at right angles to *a b*, draw perpendiculars as *h' x' x''*, *i' w' w''*, &c. &c. Next, from *o*, on the line *b e*, measure to *p*, and with this distance *o p*, set off from one point *o'* on the major axis of the ellipse *a b*, the distances *p' p''* cutting the perpendicular *p' p''* on the points *p' p''*. Next from point *n* on the line *b e*, measure to *q*, and with this distance *n q* set off from the point *n'* on *a b* to the points *q' q''*. Proceed thus till a series of points as *r' r''*, *s' s''*, *t' t''*, *u' u''*, *v' v''*, *w' w''*, and *x' x''* are obtained, through which draw by hand the curve of the ellipse. *Another method*

of finding the series of points is shown in fig. 549, in which *a b* is the minor or conjugate and *c d* the major or transverse axis or diameter, and *e f* the "foci" of the ellipse. To find these foci from the point *a'*, where the two diameters intersect each other, take in the compasses the distance *a' d* or *a' c*, and with this as radius from point *a* describe arcs cutting the major axis *c d* in the points *e* and *f*; these points are the foci. Then on the line *c a'* assume any point, as *g*, and from the point *f* as centre, with the distance *c g* as radius, describe the arc *h i*. Next with the distance *d g* as radius from the point *c* as a centre, describe another arc cutting the first in the points *h* and *i*, these will be the two first points found through which the curve of the ellipse will pass; the second two, as *j* and *k*, will be found by reversing the above process, that is with the first radius (as *c g'*), describing from centre *e* the arc *j k*, and with the second radius (*d g'*) from centre *f*, cutting the arc in *j* and *k*. To find the next two points assume again any point, as *l* on the line *c a'*, and with *c l* as radius from focus *f* as centre describe the arc *m n*, and with *d l* as radius, and from focus *e* as centre describe an arc cutting the other *m m*, and *n*. These will be fifth and sixth points in the curve, and by reversing the centres with the radii as above, namely, with radius *c l* from centre *e*, describe the arc *o p*; cutting these by other arcs described from centre *f* with radius *d l*, the seventh and eighth points will be found. To find the ninth and tenth points, assume again any point, as *q*, on the line *c a'*, and from *f* as centre with *c q* as radius describe the arc *r s*; and from *e* as centre with *d q* as radius other arcs cutting in *r* and *s*; reverse the centres as before, and the eleventh and twelfth points *t u* will be found; *x* and *w*, and *y* and *z* are found by assuming *v* as a point, and making the respective centres *f* and *e* and the radii *c v*, *d v*. To find the points *b'* and *c'*, nearer the axis *a b*, as also *e'* and *d'*, assume any point, *a''* or *c a'*, and from *f* and *e* as centres with *c a''* as radius describe arcs *b' c d' e'*, and from *e* and *f* as centres with distance at *a''* as radius, describe other arcs cutting the others in points *b' c' d' e'*. Through all the points thus obtained draw a curve by hand, which will be that of the ellipse.

TEN YEARS' EXPERIENCE OF ARBITRATION.

IF it were possible to trust external appearances under all circumstances, it might well be said that arbitration, as a solvent of disputes between capital and labour, has been little else than an ephemeral expedient, successful only under conditions that were specially favourable to its adoption. Not only have many recent appearances pointed to this conclusion, but it has been affirmed over and over again by large employers of labour, whose utterances have come with the weight of authority, and whose interest it seemed to be to give to the application of this system every facility calculated to ensure its triumph, as opposed to the arbitrament of force. How is it that arbitration is not more generally resorted to if its application is so infallible a specific for the cure of industrial ills as its votaries and supporters declare? Why do masters sometimes prefer to allow their workmen to strike, their works to be left idle, their capital to be rendered unproductive, and their reputations to be jeopardized, if arbitration is all that it is said to be? Why, on the other hand, will workmen still persist in strikes, involving wretchedness and misery to themselves and families, physical and mental demoralization, misunderstandings and conflicts with their employers, and the stirring up into active operation of all their worst impulses and passions, if arbitration can smoothe a pathway to the removal of all these and other difficulties? Such questions as these have been often asked. Perhaps they have never been satisfactorily answered. It is at all events certain that at the present moment masters and men confront each other with hostile intent in the great industries of South Wales, because to them the answer to these questions has not been adequately satisfactory, and it only seems reasonable to suppose that if arbitration could extricate the industry of the Principality from its present position of peril and loss, its application would not long be delayed. At a time like the present, when the great industries, not of England only but of the whole civilized world, are passing through the agony of reaction, when on every hand we hear of strikes and rumours of strikes, when new and serious dangers are constantly besetting our commerce, already harassed and worried by intestinal struggles almost beyond the limits of endurance, and when political economists, humanitarians, and philosophers are sorrowing as men without hope for the seemingly preventible evils that encompass them on every hand, it is opportune to consider what arbitration has already done, and what yet remains for it to do.

In order to a right understanding of the aims and functions of arbitration, it is necessary to remember the conditions under which its initial operations were conducted. The social forces of the hour have in nothing commanded so signal success as in their emancipation of the proletariat from a condition of bondage and serfdom. The time when colliers were transferred from one proprietor of a colliery to another without any exercise of their own will, like a piece of furniture or machinery, is still within the memory of living men; and only a few years have elapsed since even those who followed the most unwholesome and enervating occupations were compelled to work twelve to fifteen hours per day. The back of this reign of hardship and tyranny was broken, in the first instance, by the operations of trades unions. However much these institutions may have to answer for—and it is doubtful whether they have not been more sinned against than sinning—it is at all events undeniable that they have reclaimed the working man from a condition out of which he could never have been rescued by his own unaided individual efforts. But in proportion as unionism succeeded in this mission it became feared and hated by employers. The latter were slow to recognise in their workmen the right to dispose of their labour as a marketable commodity to the highest bidder, until this obligation was forced upon them by the power which the latter acquired from union. They were slower still to recognise the right of the accredited representatives of their workmen to conduct negotiations on their behalf. It seemed like adding insult to injury when trades unionism not only compelled employers to recognise certain rights of their workmen previously unacknowledged, but also demanded that there should henceforth be only one way of approaching their workmen on all *general* questions, and that *via* the council or executive of the union. Even yet, there are many masters who look upon this requirement as an unmitigated tyranny; and the most democratic as well as the most considerate of employers make it a rule to have as little to do with the union executive as possible. On the face of it, therefore, there is an initial difficulty of the most delicate and serious kind to be surmounted before arbitration can be undertaken in the settlement of trade disputes. Many who have approached arbitration with confidence in its efficacy, and the most sincere desire to give it a fair trial, have made shipwreck of their faith by ignoring conciliation. Men are now-a-days disposed to believe that for industrial purposes they should meet their masters on a perfect footing of equality. A labour-bargain is a matter of mutual gain or interest, and while the bargain is pending Jack is as good as his master—at all events in his own eyes. He will not, therefore, be patronized by his employer. If the latter stands too much upon his dignity, he will provoke resentment, and feelings fatal to the end aimed at will probably rankle in the minds of both. As a first principle, then, it is essential to the satisfactory adjustment of trade disputes by arbitration, that conciliation should not only enter into the negotiations, but that it should predominate over every other feeling.

It is estimated on reliable returns, that there are nearly a million and a half of trades unionists in Great Britain. Nearly a third of that number are miners, who have not yet availed themselves of the advantages of a Board of Arbitration, and yet it is among workmen of this class that strikes are most liable to arise, owing to the ever-recurring fluctuations of the iron and coal trades; another third belong to the mechanic class, embracing carpenters, masons, engineers, shipbuilders, &c.; while the remaining third will be found to be chiefly made up of ironworkers, labourers, and other classes of skilled or unskilled labour. Up to the present time there are not more than three or four—or at the most half a dozen—regularly constituted Boards of Arbitration at work in the United Kingdom, and these Boards do not extend their operations to more than a mere fraction of the ranks of labour. The principal Boards are established in connection with the hosiery and glove trades, which do not employ more than 20,000 hands; the manufactured iron trade of the north of England, where there are nearly 15,000 subscribing members; and the South Staffordshire iron trade, where there are nearly as many operatives represented as in the North of England. The area of operations covered by Boards of Arbitration has consequently been limited so far to less than 100,000 workmen.

There have, however, been numerous instances in which the principle of arbitration has been successfully applied to the adjustment of trade disputes; and there are now at work in the North of England and elsewhere, tribunals constituted on a similar basis to that of a complete Board of Arbitration, although not invested with the same full and plenipotentiary powers. The functions of these tribunals are, in fact, strictly limited to dealing with *local* as opposed to *general* disputes; that is to say, they can adjudicate upon a difference arising at an individual establishment, whether an ironworks, a colliery, or a factory, but they have not authority to interfere in matters affecting the

general rate of wages, the hours of labour, or other questions in which the men employed in one particular trade are as a whole concerned. This form of arbitration is adopted in the mining industries of Durham, Northumberland, and Cleveland, and will hereafter be referred to. On the whole, therefore, it may fairly be predicated that the area of operations covered by the system of arbitration in its various forms is sufficiently large to afford every necessary test of its results.

One of the earliest attempts made in this country to bring together on a friendly and reciprocal basis the rival and conflicting interests of capital and labour, took place in the carpet trade. It was promoted by such men as the Crossleys of Halifax, and Mr. John Henderson, the late M.P. for the city of Durham. This tribunal, formed in 1838, was much more suited to the restricted ideas of that date, than to the more advanced notions of the present time. It was, in fact, nothing more than a union of employers met together under the name of a Conciliation Board to devise ways and means for reconciling their own interests with those of their workmen. The policy of the board was declared to be "not to look solely to the financial interests of the masters, but also to consider, and as far as possible, legislate for the workmen."[1] A statement of all changes desired by the workmen was required fourteen days before the employers met, and the latter, at their meeting, received a deputation from the workmen, who were, however, compelled to retire after their case had been stated. The employers alone adjudicated, and however anxious they might be to "lay judgment to the line and righteousness to the plummet," the ordinary human instinct of self-protection would lead them, in all cases where there was a doubt, to bestow the benefit of it upon themselves. This association was a step in the right direction, in so far as it was a means of preventing isolated action among employers on the one hand, or among workmen on the other. But it was nothing more; and it seems to have been due more to accident than to the intrinsic merits of the system that since 1838 it has prevented any general strike in the carpet trade.

Of a very different character and scope was the Board of Arbitration and Conciliation formed in 1860 in the hosiery and glove trades of Nottingham, Leicester, and Derby. With the formation of this Board the name of Mr. Mundella, M.P., has been indissolubly associated. This had always been a singularly difficult trade to regulate. It had always had to maintain a sharp competition with the foreigner, and especially against the cheap labour of Saxony. The system of employing middle-masters, which is a necessity of the trade, is one liable to great abuse; and the cupidity of individual employers had at times given rise to great oppression. Irritation and dissension were chronic, and strikes, accompanied by frame-breaking and burning in effigy, were resorted to by the workmen as their only means of redress. It was after a struggle of many weeks duration in the wide-frame branch of the Nottingham hosiery trade that the Board of Arbitration and Conciliation originated. The rules originally agreed upon are the same that still continue to govern the affairs of the Board. They are very few and simple, the more important being as follows:—

1. That a Board of Trade be formed, to be styled the "Board of Arbitration and Conciliation for the Hosiery and Glove branches."

2. That the object of the said Board shall be to arbitrate on any question relating to wages that may be referred to it from time to time by the employers or operatives, and by conciliatory means to interpose its influence to put an end to any disputes that may arise.

3. The Board to consist of nine Manufacturers and nine Operatives, the Operatives to be elected by a meeting of the respective branches. The Manufacturers to be elected by a public meeting of their own body. The whole of the deputies to serve for one year, and to be eligible for re-election. The new council to be elected in the month of January in each year.

4. That each delegate attend the Board with full powers from his own branch, and that the decision of the Board shall be considered binding upon the branch he represents.

5. That a Committee of Enquiry, consisting of four members of the Board, shall inquire into any cases referred to it by the secretaries, such committee to use its influence in the settlement of disputes. If unable amicably to adjust the business referred to it, it shall be remitted to the Board for settlement; but in no case shall the committee make any award. The committee to be appointed annually.

6. That the Board shall at its Annual Meeting elect a President, Vice-President, and two Secretaries, who shall continue in office one year, and be eligible for re-election.

7. That the Board shall meet for the transaction of business once a quarter, viz., the first Monday in January, April, July, and October, but on a requisition to the President, signed by three members of the Board, specifying the nature of the business to be transacted, he shall within seven days convene a meeting of its members; the circular calling such meeting shall specify the nature of the business for consideration, provided that such business has first been submitted to the Committee of Enquiry, and left undecided by them.

8. That all complaints submitted to the Board for their investigation, be embodied in writing, stating as clearly as possible the nature of the grievance complained of, such statement to be sent at least one week prior to the Board meeting.

9. That the President shall preside over the meetings of the Board, and in his absence the Vice-President. In the absence of both President and Vice-President, a chairman shall be elected by the majority present, the Chairman to have a vote, and in case of numbers being equal, the Chairman to have the casting vote.

The formation of the Nottingham Board was regarded as a doubtful experiment. Several manufacturers, we are told, were openly or covertly hostile to it. It was regarded by others as Utopian and impracticable, while others, again, were afraid that it would be likely to pry into their business. But the greatest opposition of all came from those who looked upon it as derogatory to their position and independence as employers. All these objections and animosities were in course of time surmounted, until the friends of arbitration can to-day declare that since the Nottingham Board was founded no strike or lock-out has taken place, and at times when agitations on the question of wages were prevalent throughout England, manufacturers in this branch of industry had been able to accept contracts without apprehension, and to execute them without delay.[1]

The remarkable and unequivocal success that attended the first really efficient and complete Board of Arbitration established in the United Kingdom, directed the minds of thinking men to an investigation of the merits of the system. But it was not until some years after that a like tribunal was established to regulate the relations of employers and employed in the building trade of Wolverhampton. The apostle of the first Arbitration Board was Mr. Mundella, M.P., that of the second was Mr. Rupert Kettle, the County Court judge of Wolverhampton. The latter gentleman drew up the code of rules governing the operations of the Wolverhampton Board. The *rationale* of the Wolverhampton system did not materially differ from that of Nottingham, and both have been completely successful in realising the expectations of their promoters, no general suspension of labour having taken place since their establishment in the industries to which they were applied.

The Board of Arbitration and Conciliation in the manufactured iron trade of the North of England was established in 1869, on a suggestion made by Mr. David Dale, its first president. Previous to that time strikes and lock-outs had been of frequent occurrence in this branch of the iron trade. A lock-out of six weeks' duration took place in 1865, and in the following year there was a strike attended by almost equally disastrous results. There are thirty-three different firms engaged in the manufactured iron trade of the North of England, employing from 13,000 to 20,000 hands. Every one of these firms, with the single exception of Fox, Head, and Company (whose works are conducted on the co-operative principle, and who, on that account, refrain from association with other employers), are connected with the Board, which was founded on the principle adopted in the Nottingham hosiery trade, modified and improved to suit the exigencies of the iron trade. Instead of limiting the number of representatives of the respective parties to seven or nine, as in Nottingham, the North of England Board was formed on a basis which allowed one employer and one operative to be elected from each work connected with the Board. There are, consequently, thirty-three representatives on each side. A considerable outlay is incurred in carrying on the operations of the Board. This is provided for by the employers contributing in a ratio corresponding to the number of workmen they employ, while each workman contributes one penny per month or a shilling per year. All cases of dispute are in the first instance referred to the consideration of the Standing Committee, composed of a limited number of the representatives of each side. If the Standing Committee can, by conciliation, effect an amicable settlement of disputes, good and well, but it has no power to make an award. If it fails to settle a difficulty by conciliatory means, then the matter in dispute is referred to the whole Board, who first discuss and then vote upon it. Should the board fail to come to an agreement in this way, then the whole case is placed in the hands of an umpire, whose decision both sides are pledged to regard as binding and final. All questions affecting the general rate of wages are dis-

[1] "Industrial Resources of the Tyne, Wear, and Tees," p. 241.

[1] Vide statement signed by employers and operatives.

posed of by the Board as a whole; while local questions, affecting only individual works, are adjudicated on, where possible, by the Standing Committee. By this arrangement the course of business is at the same time simplified and facilitated, while the machinery in operation is, *ab initio*, so exhaustive and perfect that ultimate failure is rendered impossible, if each side remains true to the pledges involved in its membership.

The annual reports of the Board of Arbitration in the North of England iron trade have borne unvarying testimony to the efficiency and success of the system. Both masters and men have found its operation to be of the greatest possible value in guiding them to a proper understanding of each other, and of each other's affairs, and unbroken harmony has from the first pervaded every relation that has taken place between two apparently antagonistic elements. In the words of its able president, "the Board has, over a period marked by considerable fluctuations in trade, kept the great iron industry of the North of England free from strikes. And this not merely by settling under arbitration the general changes in wages, but by investigating and deciding the very many minor differences which necessarily arise at individual works. In each of these cases, the Standing Committee acted virtually as arbitrator, and in no case have the parties concerned failed to abide by its decision."

A very few words will suffice to complete this part of our subject. The ironmasters of Staffordshire, acting on the solicitations of their workmen, agreed in 1872 to the formation of a Conciliation Board, which is conducted on the same lines as the Board of the North of England, with this important exception, that the employers decline to accept the compulsion and finality of arbitration. The rules governing the Staffordshire Board do not make it absolutely incumbent to call in an umpire, in cases of dispute, and the absence of such a provision largely tends to destroy the efficiency of the system, which in this case is in constant danger of coming to grief. It is, of course, open to either side to propose arbitration, in case they fail by meeting and discussing together any point of difference, to arrive at a conciliatory settlement. But neither side is bound absolutely and without reserve to proceed to arbitration in the event of such a failure, and where the compulsion does not exist there is no certain guarantee of permanent peace and concord. A Conciliation Board, however, in spite of its weakness and insufficiency, is a step in the right direction, and has so far proved that even conciliation without arbitration may be made largely instrumental in fostering and maintaining an abiding peace between masters and men.

Reference has already been made to the establishment in the coal trade of Durham and Northumberland, and in the ironstone mining trade of Cleveland, of a joint committee of masters and men, appointed on the one hand by the Operatives' Union, and on the other by the Masters' Association, which is intended to serve the purposes of an arbitration board in dealing with local disputes. The following are the rules which guide the action of the Joint Committee in the Cleveland mining district:—

1. The object of the committee shall be to arbitrate, appoint arbitrators, or otherwise settle all questions (except such as may be termed county or district questions, or questions affecting the general trade), relating to matters of wages, mode or manner of working, or any other subject which may arise from time to time at any particular mine in the Cleveland district, and which shall be referred to the consideration of the committee by the parties concerned. The committee shall have full power to settle all disputes, and their decision to be final and binding upon all parties, in such manner as the committee may direct.

2. The committee shall consist of six representatives, chosen by the Miners' Association, and six representatives chosen by the employers or mine-owners of Cleveland.

3. At meetings of this committee it shall be considered there is no quorum unless there are three representatives of each side present.

4. Each meeting shall nominate its own chairman, who shall have no casting vote. In case of equality of votes upon any question, it shall be referred to two arbitrators, one to be chosen by the representatives of the employers, and one by the representatives of the Miners' Association, the arbitrators, in case of difference, to appoint an umpire in the usual way.

5. Each party to pay its own expenses; the expenses of the umpire to be borne equally by the two parties concerned in the dispute.

6. Should any alteration of, or addition to these rules be desired, notice of such change or alteration must be given at the meeting previous to that at which its discussion is to take place.

7. If any member of the committee is directly interested in any question under discussion, he shall abstain from voting, and one member of the opposite party shall also abstain from voting.

8. When any subject has to be considered by the committee, the secretary on either side, by whom it is to be brought forward, shall give notice thereof to the secretary of the opposite side, at least three clear days before the day of meeting, at which such subject is to be discussed.

Wherever a joint committee has been established in the mining or metallurgical industries of this country, the rules have been very similar to the foregoing. The functions of the joint committee are essentially the same as those of the standing committee of the North of England Board of Arbitration. There is, however, one important difference between the two tribunals. When the standing committee fail of agreement, the matter in dispute is referred to the board, which has power to make and enforce an award. Where there is no board of arbitration as an ultimate court of appeal, any matter on which the joint committee may fail to agree is referred to experts, who investigate and report upon the issues in dispute, and whose reports are generally accepted and confirmed without special judicial inquiry by the joint committee, much in the same way as the award of an arbitrator invested with full plenipotentiary powers.

It is obvious that for purposes of local arrangement, this is at once the most easy and the most expeditious plan that could be devised. Such minor disputes are continually arising, and sometimes, unless promptly met and checked, they assume serious proportions and involve protracted suspensions of labour. Many different causes bring them about. The question of overtime, the dismissal of a fellow-workman on what are believed to be insufficient grounds, the conduct of an obnoxious overseer, the kind and quality of raw materials supplied, the introduction of new processes and appliances—these and many other matters in which employers and employed have a mutual concern, are liable to provoke animosities and misunderstandings which are only to be allayed by a timely and judicious adjudication upon the facts submitted by the complainants. If it were possible to form a joint committee of this kind in every large seaport town, to arbitrate on matters of dispute arising between shipowners and sailors, it would probably be better for both sides, and Mr. Plimsoll's aims would to a large if not to the utmost practicable extent, be realized without the special interposition of parliamentary powers. A pitman is not bound to descend a shaft that he believes to be unsafe, and no more fertile cause of local disputes has been created in the coal trade than that which relates to the safety of life and limb. If complaint is made in the Durham and Northumberland coal trade, that a mine or any part of the workings of a mine is unsafe, it is the duty of the joint committee to investigate such complaint; and the complainants are bound to abide by the decision of the experts appointed by the joint committee to investigate the causes of complaint. *Ab uno disce omnes.* The functions of the joint committee, then, are strictly limited to the investigation of local disputes, while the more extensive and general questions of the rate of wages and the hours of labour are otherwise disposed of.

Some of the more obvious practical lessons inculcated by the experience of arbitration in the last ten years, demand earnest and thoughtful consideration. We have shown to some extent what arbitration has already done; but a great deal yet remains for it to do, if the prejudices now opposed to its adoption could only be got out of the way. Those who have carefully refrained from affording a fair chance to the system are continually croaking about its inquisitorial tendencies, and offering other objections of a more or less imaginary and hypothetical character to its use. Nay, more, so dense is the ignorance prevailing on the real *modus operandi* of arbitration, that some employers otherwise most reasonable and intelligent, entertain the most profound conviction that they cannot resort to this "easy, artless, unencumbered plan," without yielding up to their workmen a knowledge of their secrets, and particularly of the profits which they enjoy. Were such an objection really well founded, it would be practically unanswerable, for no employer could be expected at this time of day—although industrial partnerships, if some opinions are to be trusted, may in the future inaugurate a new era,—to take his workmen so much into his confidence as to disclose the most exclusive and cherished secrets of his business. In the manufactured iron trade of the North of England, there is, perhaps, the most perfect and complete adaptation of arbitration to the settlement of trade disputes that has yet been devised, and here, also, the inquisitorial tendencies of the system are manifested to their fullest extent. Let us see, then, how in the North of England the formidable character of this great bugbear is so changed, that confidence takes the place of fear, and security is installed in the room of danger. An accountant of mature experience and undoubted reputation is appointed by the mutual consent of masters and workmen to inquire into the condition of the iron trade over such an antecedent period as

may be determined on, with a view of fixing the rate of wages over a prospective period of corresponding extent. It is the duty of this accountant to ascertain from each firm connected with the Board, the quantity of manufactured iron of all kinds made at each works over the period to be adjudicated on, and the average net price per ton at which the iron so manufactured has been sold. This information each firm connected with the Board is pledged to afford in the most exact manner possible; but the accountant may if he so thinks fit, or if the Board should so determine, make a personal examination of the books of each firm, and ascertain the quantities and prices for himself. Having collected returns from each of the thirty-three firms connected with the Board, the accountant proceeds to abstract the quantities of each different class of iron, and by adding them together he arrives at the total weight invoiced of each. It is then a simple matter of figures to reach the average net selling price per ton of the whole weight invoiced, and upon this price the wages of the men are based for such a period as may be agreed upon. It is usual in the North of England to have quarterly settlements so that wages are regulated afresh every three months. The following report of the accountant for the three months ending November, 1874—the latest date of adjudication—will explain the *rationale* of the system more clearly :—

To the Chairman and Members of the Board of Arbitration and Conciliation for the Manufactured Iron Trade of the North of England.

"Gentlemen,—Having collected from the firms and companies belonging to your Board, the returns of their sales of manufactured iron during the three months ending 30th November, and having verified the same by an examination of their books, I certify the average net selling price per ton for that period to have been £9 1*s.* 5*d.*

"Annexed is a statement of the different classes of iron sold and the average net selling price of each :—

SALES DURING THE THREE MONTHS ENDING 30TH NOV., 1874.

	Weight Invoiced. Tons.	cwts.	qrs.	lbs.	Percentage of Total.	Average net price per Ton. £	s.	d.
Rails	62,369	4	2	16	41·02	8	9	0·44
Plates	48,458	0	1	0	31·87	9	13	1·2
Bars	28,266	3	0	26	18·59	9	7	11·6
Angles	12,944	19	3	11	8·52	9	3	1·91
	152,038	7	3	25	100·—	9	1	5·13

I am, gentlemen, your obedient servant,
(Signed)
EDWIN WATERHOUSE."

No one except the accountant sees or knows any more than the above, and he, of course, is pledged to the utmost secrecy as to the operations of the different firms included in the aggregates on which the wages of the men are based. Starting then *ab initio* into the principle that the wages of puddlers and millmen should be paid according to the realized value of the iron which their labour is employed to produce, it becomes necessary to fix the relation which wages should bear to profits, or, in other words, to assess the rate at which iron workers should be remunerated, having regard to the ascertained selling price of iron. This has hitherto been done in the finished iron trade by mutual approval of a scale known as the Thorneycroft standard, according to which the wages of puddlers are fixed at 1*s.* per pound per ton of realized value, and 1*s.* over—*i.e.*, if rails, plates, bars, and angles produced an average net selling price of £9 per ton, the wages of puddlers shall be 10*s.*, and so on, according to the ever-varying fluctuations of the market. Theoretically this principle is all that could be desired, but in practice it has occasionally been found to involve hardship and difficulty. Hence the Board, some years ago, adopted a sliding scale of rather a different kind. This scale provided that a change in prices equal to 3*d.* per ton in puddling, and 2½*d.* in other wages, be made for each fluctuation of 5*s.* in the selling prices, above or below a fixed standard of £6 17*s.* 6*d.* per ton realized price of iron in relation to the wages prevailing since June 1st, 1873. The effect of this arrangement will be seen from the following illustration :—

To justify an advance of	The net selling price must come up to
2½ per cent.	£7 0 0
5 „ „	7 5 0
7½ „ „	7 10 0
10 „ „	7 15 0

And so on.

To justify a reduction of	The net selling price must come down to
2½ per cent.	£6 15 0
5 „ „	6 10 0
7½ „ „	6 5 0
10 „ „	6 0 0

And so on.

The abnormal condition of the iron trade during the last two and a-half or three years has caused this eminently sound and equitable form of sliding scale to be abandoned in favour of another, which fixes a minimum of 9*s.* 6*d.*, and a maximum of 12*s.* 6*d.* per ton, within which wages must fluctuate. But no matter what form such a scale may take, the principle is always the same. By no other principle or method yet contrived can wages be so nearly adjusted to profits, and this is, theoretically, the relation which the one ought to occupy towards the other. It is all very well in theory to advocate that wages should rise or fall in exact proportion to profits; but to carry out any such rule in its integrity would be found utterly impracticable. Employers would never, under any circumstances, consent to a knowledge of their profit being made public, and workmen could not afford to labour without reward in times of great depression, when no profits were available. But under the system above described the workman is guaranteed "a fair day's wage for a fair day's work," no matter whether his employer is making profit or loss, and both sides are equally well satisfied with the arrangement.

One of the greatest and most perplexing difficulties that industry has now to face arises out of the condition of uncertainty that always prevails as to the prospects of trade, and the consequent absence of definite knowledge as to the period over which a certain rate of wages may fairly be paid. In some trades the wages vary to an infinitesimal extent, and then only at long intervals. This, however, is not the case in the iron and coal trades. Both of these great staple industries are passing through constant vicissitudes. The operations of a ring of speculators on 'Change, the rise and fall of the rate of discount, the withdrawal from the Bank of a large amount of bullion, the rumour of a war on the Continent, and many other causes that have not the remotest influence on tailors, shoemakers, or carpenters, are continually tending to disturb and unsettle those who deal in iron and coal. Should the market sustain a sudden fall, employers naturally look for a reduction of wages to enable them the more fully and easily to respond to the exigencies of commerce. If, on the other hand, there should be a rise of prices, workmen at once claim that in sympathy with the improvement of trade their wages should be advanced. Constant alternations of prosperity and depression involve continual revisions of the rates of wages paid in these industries, and it is therefore extremely difficult—much more so than in any other industries—to maintain conciliatory and amicable relations between employers and employed. To strengthen such relations and enable both masters and workmen to calculate further ahead, it was proposed at one time to introduce into the manufactured iron trade of the North of England a system of time-bargains. One of these bargains was entered into in the beginning of 1872, when the trade and commerce of this country experienced a revival altogether without parallel, and when, to quote Mr. Gladstone, we advanced "not by steps but by strides; not by strides, but by leaps and bounds." It so happened that the bargain was bad for the men, who had their obligation to abide by the arbitrator's decision put to a strong test. Under the circumstances, the employers agreed to allow a 5 per cent. advance of wages over and above what the men were entitled to under the arbitrator's award; but the experience gained on that occasion established the gratifying conclusion that a large body of men, imperfectly trained in habits of self-restraint, and not fully educated up to the point of recognizing permanent rather than immediate advantages, were nevertheless willing to abide by bargains, even when operating against them, if such bargains were not adverse over too long a period or to any unexpected extent. The self-adjusting scale already alluded to was introduced, not to enable time-bargains to be dispensed with, but in order that such bargains may be as short as possible and adapted as nearly as may be to the current state of trade. Believing, then, that it is not well to contract too far ahead, the Board now limit their arrangements to a period of three months. In cases where arbitration has been resorted to as a casual and temporary expedient, the system of time bargains has been ignored. The arbitrator's function is confined to a declaration of the rate of wages that should be paid at the time he makes his award; and it is competent for either side to propose an alteration within a month afterwards if they so think fit. To seek to set aside an award in this way would of course be tantamount to a charge of *mala fides*, unless, indeed, trade had meanwhile taken a very sudden and considerable bound; and it is creditable alike to masters and

men that in few cases, if any, where wages have been arranged under arbitration, have attempts been made to set aside the award of the arbitrator within, at the least, a period of three months.

There is still a want of agreement even among those who may justly claim to rank as the pioneers of arbitration, as to the exact mode in which it can most easily and advantageously be conducted. The invariable rule has been to refer matters in dispute to the adjudication of one arbitrator; and this custom has received the presumptive sanction of the Boards of Arbitration in Nottingham and the north of England. In some recent arbitrations, however, in Northumberland, Durham, and elsewhere, the more elaborate and complicated course of appointing two arbitrators on each side has been adopted. Both systems ultimately reach the same end by the same means, for it is necessary in the event of these four arbitrators failing to agree, to appeal to a referee whose decision is final and binding. In reference to the first system it is to be observed that there may be some difficulty in choosing an umpire who has the unlimited confidence of both sides; and upon this rock negotiations are liable to split. The danger liable to arise from this source is, however, very small; and the objection against a single arbitrator is both trivial and untenable as compared with that which may fairly be urged against the appointment of four. For it will follow as unerringly as a shadow follows its substance, that each side will appoint men of its own sympathies and predilections, and it is not less certain that four men whose mode of life, idiosyncrasies, and interests are so diametrically opposed, will fail to agree, so that for all practical purposes their appointment is a sham and their position is one that tends to supererogation. It is difficult in such a case to determine where the line is to be drawn between the functions of the advocate and those of the arbitrator. Each, in his anxiety lest the other should steal a march upon him, is likely to be animated by a strong desire to set the case of his *clientèle* in the most advantageous light possible, and—even while the arbitration is in progress—difficulties are liable to arise involving a loss of judicial dignity on the part of the arbitrators, and misunderstandings between the parties concerned in the result. But, besides all this, it may be laid down as an unvarying and irrefragable principle that no one who is not altogether without prejudice and bias, is properly qualified to act as arbitrator. Under this system, however, that which should be a man's most paramount qualification for the discharge of an arbitrator's functions, is likely to be made an argument against him. In the recent arbitration on the Durham miners' wages, the two arbitrators appointed to act for the masters—Mr. Leeman, M.P., and Mr. David Dale—had both a very large pecuniary interest in the award, while the arbitrators appointed on behalf of the workmen were similarly interested in another direction. The most ready and rational way of conducting an arbitration is that of leaving the issue in the hands of one man who is entirely free from pecuniary or personal interest, and whose prejudices are not likely to be influenced in favour of either one side or the other. It is his eminently dispassionate and unbiassed manner of dealing with such cases, not less than his eminent judicial capacity, that has made Mr. Rupert Kettle the most popular, and, without invidious distinction, we might add, the most efficient arbitrator of his time.

Although much more remains to be said upon this subject we cannot here give it more extended consideration. Little need be added by way of enforcing the moral to which our remarks have pointed. Strikes have been divided by Mr. Kettle[1] into three classes—namely, (1) differences upon the terms of a future contract; (2) disagreements upon the terms of an existing contract; and (3) quarrels upon some matters of sentiment. To each and all of these cases, arbitration has been successfully applied, and we dare venture to say that while every other expedient for the settlement of trade disputes has more or less incurred the reproach of failure, arbitration alone has stood the searching test of time. Not from one source only, but from every source whence such information is available, there comes a remarkable concurrence of testimony in favour of this system, and in all cases of its application the end aimed at has been attained. It may be said that although it may suit some trades, it will not serve for all; but there is no industry where wages are so varied and so liable to fluctuation, where the conditions of labour are so perplexing and different, and where, on the face of it, there exists such a hopelessness of governing wages and prices by fixed principles, subject to the laws of arbitration, as in the finished iron trade; and the friends of reason are fairly entitled to urge that if, in this industry, wages can be regulated without the arbitrament of force, there is no other industry so special and peculiar as to be outside the pale of similar treatment. Arbitration of this kind is only in its infancy, but if it should realize the bright promise of its early days, we may with hopeful confidence look for the dawn of a later day when the highest degree of odium and even of criminality will attach to the conduct of those whose evasion of the dictates of reason—not to speak of obliviousness to their own best interests—may lead them to encourage or enter upon a conflict which can settle nothing except that one can hold out longer than another, instead of resorting to the mediation of humanity, justice, and common sense.

J. S. JEANS.

[1] "Strikes and Arbitration, with the Procedure and Forms successfully adopted in the Building Trade of Wolverhampton," by R. Kettle.

Engineering, Building, &c.

ABSTRACTS FROM FOREIGN PERIODICALS, TRANSACTIONS OF SOCIETIES, &c.

§ 1. *Engineering.*

NEW Telescope for Surveying Instruments.—M. GOULEAU directs attention to a new form of telescope for surveying instruments, which has been manufactured during the last five years by M. BELLIENI, formerly of Metz and now of Nancy. The instrument has never been described before, and is comparatively unknown. It is an improvement on the "lunette anallatique" of Colonel Poggio, of the Piedmontese Engineers, but, unlike the original, is very small and handy. It is stated to give very satisfactory stadiometrical results. A miner's compass, constructed at the School of Engineering at Metz, and fitted with one of these telescopes, weighed altogether no more than 2·3 kilogs. (5 lbs.) The subjoined dimensions have been found to answer best. The distances are measured from the optical centres of the lenses, and include the thicknesses of the latter.

	Focal lengths.	Actual diameters.	Distances between the lenses.
	millm.	millm.	millm.
Objective O	230·0	24·5	
Displacement glass O, plano-convex	125·0	13·0	206·5
Field glass O′, concave-convex; rad. of concave surface 15 lines, rad. of convex surface 5 lines	31·7	11·0	11·5
Eye-piece O‴, bi-convex; rad. of one surface, 15 lines, of the other 5 lines	11·9	6·0	21·0
Effective diameter of objective	—	—	21·0
Magnifying power	—	—	$\frac{5}{2}$ Twelve times
Distance of objective from centre of displacement	—	—	122·0
Distance of O″ from the diaphragm carrying the stadiometric threads	—	—	9·5
Diameter of aperture of the same diaphragm	—	—	5·1
Distance between the threads under a stadiometric angle of $\frac{1}{30}$	—	—	3·05
Distance from eye to O‴	—	—	5·1
Distance through which eye-piece has to be moved to render an object visible at 3 metres	—	—	11·9

Comptes Rendus, lxxx. 5, *1st Feb.* 1875.

New Measuring Wheel and Curveometer.—M. RUD. WITTMANN has patented a new measuring wheel, which is figured and described in the undermentioned journal. It is a light cast-iron wheel, carrying, on its axle, a new and ingenious indicator for registering the distance traversed, and provided with a knife-edged plate working against a short spiral spring, by which the circumference is kept free of mud and dirt. The wheel is made in two sizes: No. 1, with a diameter of 1 metre, No. 2, with a diameter of 2 metres. It can be used by one man with perfect ease. The reading of the indicator is perfectly simple, and offers no sort of difficulty.

In a series of trials with a No. 1 wheel, Professor Tinter obtained the following results, proving that, even under unfavour-

able circumstances and at long distances, its accuracy was not inferior to good chaining.

1. *Very bad stone pavenent.*—Wheel used slowly. Mean errors in six measurements of 100 metres, $\frac{1}{1114}$ of distance. Do. in six measurements of 20 metres, $\frac{1}{1067}$.

2. *Very good footpath.*—Wheel used slowly. Mean errors in five measurements at each of the undermentioned distances:—100 m. $\frac{1}{1340}$, 200 m. $\frac{1}{1333}$, 300 m. $\frac{1}{1759}$, 400 m. $\frac{1}{2222}$, 500 m. $\frac{1}{3333}$ of distance.

3. *Very good level footpath.*—Wheel used at high speed. Mean error in eight measurements at the following distances:—100 m. $\frac{1}{989}$, 200 m. $\frac{1}{1096}$, 300 m. $\frac{1}{1064}$, 340 m. $\frac{1}{1275}$ of distance.

4. *On a not particularly well kept tramway.*—Slowly. Error in six measurements at the following distances:—100 m. $\frac{1}{3342}$, 200 m. $\frac{1}{3342}$, 260 m. $\frac{1}{4324}$.

5. *On a railway, straight run.*—Slowly. Mean error in seven measurements at each of the following distances:—100 m. $\frac{1}{1600}$, 200 m. $\frac{1}{1813}$, 300 m. $\frac{1}{5980}$, 400 m. $\frac{1}{7983}$, 600 m. $\frac{1}{4273}$, 700 m. $\frac{1}{8731}$ of distance.

Trials of a No. 2 wheel over the same ground as in the second series of experiments with No. 1, gave the following mean errors at the several undermentioned distances:—200, $\frac{1}{1338}$, 300, $\frac{1}{1880}$, 400, $\frac{1}{2576}$, 500, $\frac{1}{3140}$ of the distance.

In every case the indicator mechanism was found to work admirably.

Under the name of "Curveometer" a miniature form of the same instrument is proposed by the inventor for measuring curved lines on plans, etc. *Zeitschrift für d. Oest. Ingr.- und Architek.- Verein*, 2, 3, 1875.

Speed of Circular Saws.—In a report addressed to the Industrial Society of Mühlhausen on the subject of a safety apparatus for circular saws, which is at present under trial, M. HELLER, inspector of the Association for the Prevention of Accidents, calls attention to the absence of satisfactory data respecting the rates of speed best suited to circular saws of different dimensions. Assuming, on the authority of a manufacturer at Mühlhausen, M. Gaspard Zeigler, that 1,800 revolutions per minute is the most effective speed for a saw 40 centimetres (16 in.) in diameter, M. Heller has made the following calculations of the most advantageous rates of speed:—

Diameters of circular saws.	Number of revolutions per minute.
90 centimetres	800
70 „	1,030
50 „	1,440
40 „	1,800
25 „	2,880

Diametrically opposed to these conclusions are the data furnished by another manufacturing firm, which are as follow:—

Diameters of circular saws.	Number of revolutions per minute.
70 centimetres	1,232
40 „	1,085
30 „	983

Bulletin de la Soc. Indust. de Mulhouse, Dec. 1874.

Artificial Springs.—M. ROUBY proposes the formation of artificial water-sources, or rathercisterns, cut off from all direct contact with the air, for the supply of industrial establishments in times of drought. A cistern of this description should be so placed as to give the requisite flow of water without the aid of a pump, and should have a capacity sufficient to supply the wants of the establishment for rather more than one hundred days, the duration of the longest recorded drought. It should be formed of masonry set in cement, and vaulted over, the upper portion turned with an inverted arch to form a bowl, in the bottom of which, corresponding with the crown of the vault beneath, is placed a close iron grating, through which the water makes its way into the cistern. This bowl may be filled with suitable filtering materials. The adjacent ground, or suitable portions of it, are dug out to a minimum depth of 60 centimetres (2 ft.) over an area sufficient to give the requisite water supply, depending, of course, on the average rain-fall of the locality. The excavated portions are formed with a slope of 1 in 100 towards the mouth of the cistern, and covered with a 10 centimetre (4 in.) bed of burned clay, well rammed; over this is placed a layer of flints, and the ground is filled up to the natural level of the ground with sand. *Bulletin de la Soc. Indust. de Rouen, Oct.-Dec.* 1874.

Cleaning the Boiler-tubes of Locomotives.—WEINLIG recommends a copper pipe, 5 millimetres in diameter, tapering at one end, and fitted at the other with a flexible india-rubber tube, by which it can be connected with the steam-cock of the boiler when required. The pipe is mounted on a 3 ft. wooden handle, and should be long enough to reach through the fire-box. In use, the wooden handle is held firmly under the right arm, and the nozzle of the pipe introduced an inch or so within the tube to be cleaned. Steam is then turned on through the india-rubber tubing. The jet of steam clears the tube or flue thoroughly without impeding the action of the boiler. *Neue Deutsche Gewerbe-Zeitung*, 3, 1875, *from Mittheil. des Magdeburger Vereins.*

Soluble-Glass Grindstones.—BAERLE and Co., of Worms, employ a composition of grit, soluble glass, and petroleum for grindstones. These stones will bear a very high speed—1,000 to 2,000 revolutions per minute, according to size—without becoming soft and greasy, like those made of caoutchouc and shellac. They are made in twelve different sizes, from 10 centimetres to 52 centimetres in diameter, with ten different thicknesses and three degrees of fineness for each size. The price of the smaller sizes varies from 1·8 marks (*1s. 9d.*) for a stone 10 centimetres in diameter and ½ centimetre broad, to 5 marks (*5s.*) for a stone 20 centimetres in diameter and 6 centimetres broad. The price of the larger sizes varies from 4½ to 23 marks per centimetre of breadth. *Industrie-Blätter, 25th Feb.* 1875, *from Hessische Gewerbe-Blatt.*

Improved Sewing Machine for Woollen Yarn.—MADSEN, of Herning, patents (in Denmark) an improved sewing-machine for woollen and coarse yarns generally. It is stated to be simple in principle and well suited to family use. *Industri-Tidenden (Copenhagen), 10th Jan.* 1875.

Improved Horizontal Windmill.—MM. ACHEN of Copenhagen, and JAPPE of Smaland, patent an improved form of horizontal windmill, with triangular sails, which appears to obviate some of the objections hitherto urged against mills of this description. The construction is particularly simple, and well suited to saw-mills and other similar purposes. *Industri-Tidenden (Copenhagen), 14th Feb.* 1875.

[The details given by our Danish contemporary are scarcely minute enough for practical purposes, but, judged by the figure given, this mill would be admirably suited for colonial work. Particulars can be obtained from one of the patentees, M. A. Achen, architect, 11, Falconer Allée, Copenhagen.]

Portable Steam Brick-making Machine.—TIDSTROM, of Konsor, patents a brick-making machine of 8-horse power, with which two men (exclusive of carriers) can turn out twenty-five clean, well-pressed bricks per minute, or 25,000 bricks in a working day of ten hours. *Industri-Tidenden (Copenhagen), 17th Jan.* 1875.

Heating Marine Boilers with Carbonic Oxide.—The Austro-Hungarian Minister of Marine is understood to have directed a trial to be made at Pola, on board the iron-clad steam-frigate "Drache," 500 horse-power, of a method of heating boilers with carbonic oxide proposed by M. FRIEDMANN in his report on the Marine Department of the late Vienna Exhibition. The carbonic oxide is generated on board by the combustion of ordinary fuel in a small upright furnace similar to those used in iron-smelting. As the gas rises in the furnace it is led off through pipes traversing the heating surfaces of the boilers, where it is burned by some of the methods in ordinary use. Special arrangements are provided for preventing any leakage or escape of the gas. The advantages claimed for the scheme are:—

1. *Greater simplicity of construction and reduced weight of the boilers.* In place of large boilers, smaller tubes may be employed, giving a greater proportion of heating surface for equal capacities. A larger proportion of heat may be imparted to the water, which, apart from the superior pyrometric effects of gas-heating, will enable improvements to be made, and a higher pressure to be used in the boilers. The boilers will last longer, as the fire-room may be changed at will. Alterations will be more easily effected, as the size and weight of the boilers will be much less than those now in use. Less engine-room will be required, and steam will be got up quicker, as the heating surface will be proportionately larger than at present is attainable.

2. *The engineers' duties will be lessened.* For example: an engine of 1,000 nominal horse-power with a fire-surface of 2,000 square metres now requires, exclusive of engine-room duties and general superintendence, twenty stokers and coal trimmers in each watch; with gas-heating, five hands would be sufficient, who would need no special training for the purpose. The boiler-effect will not, as now, depend greatly on the stoking, varying with the personal and individual capacities of each watch; the continual heaving up of the ashes will no longer be necessary; there will be no draught of cold air to reduce the temperature of the furnace; the putting out of the fires when the water has run too

low will be effected instantaneously and without risk. There will be no clearing of the fire-bars, chimney, &c., and the latter will emit no smoke.

3. *Inferior qualities of fuel may be used, and there will be increased economy of space in the coal-bunkers.*

4. *Less dependence on foreign sources of coal-supply will be requisite. Technologiste, Feb.* 1875.

On certain Mechanical Properties of Saturated Vapour.—M. ANTOINE gives the annexed simple formula, which admit of useful practical application :—

Let T represent the tension of vapour of water in degs. Cent., P, its maximum elastic force in atmospheres, F, the same in centim. of mercury, V, the volume in kilogs. Then we have :—

$$(1)\ P\,V^{1\cdot1} = 3538.$$
$$(2)\ P\,V = \sqrt{c + 55}.$$

Representing temperature over 55° above the melting point of ice by T, we have :—

$$(3)\ P\,V = 135\,T^{0\cdot50}.$$

Eliminating V in (1) and (3), we get :—

$$(4)\ P = \left(\frac{T}{155}\right)^{5\cdot5} \text{ and } F = 76 \times P = (0\cdot014175 \times T)^{5\cdot5}$$

Eliminating P in (1) and (3) :—

$$V = \left(\frac{685\cdot8}{T}\right)^{5} \text{ or } V = 0\cdot1517\left(\frac{1000}{T}\right)^{5}.$$

Representing the weight of a cubic metre of steam by $\tilde{\omega}$:—

$$\tilde{\omega} = 100 \times \frac{1}{V} = 0\cdot06584\left(\frac{T}{100}\right)^{5}.$$

Taking the tensions of other vapours, as determined experimentally by Regnault, and given in *Mémoires de l'Académie*, vol. 26, we find that, in practice, they may be represented by the subjoined very simple formula :—

Carbonic acid . .	F^{i}	$= (0\cdot020184\ T^{i})^{5\cdot5}$
Ether . . .	F^{ii}	$= (0\cdot013867\ T^{ii})^{5\cdot5}$
Vinous alcohol . .	F^{iii}	$= (0\cdot01550\ T^{iii})^{5\cdot5}$
Chloroform . .	F^{iv}	$= (0\cdot012883\ T^{iv})^{5\cdot5}$

The temperatures in these formula commence as below :—

Carbonic acid . .	F^{i}	above	208° C.
Ether . . .	F^{ii}	„	123° C.
Vin. alcohol . .	F^{iii}	„	64° C.
Chloroform . .	F^{iv}	„	110° C.

Comptes Rendus, lxxx. 7, 15*th Feb.* 1875.

§ 2. *Building, Decoration, &c.*

Ambroselli's Compo' for Brickwork.—In January last, the silver medal and prize of the value of 1,500 marks (£75) offered six years previously by the Prussian Verein zur Beförderung des Gewerbefleisses, for the best composition for facing brickwork, was awarded to M. AMBROSELLI, a master-bricklayer of Neu Barnim, near Wreizel, for a composition used on a large scale for the cornices, window-mouldings, &c., of the Villa Abel, near Potsdam, and found to have stood the test of two winters well. The conditions of the prize were that the composition should resist the action of wet, sun, and frost, should take a good even colour all through, or at least to a suitable depth below the surface, and should not be more expensive than ordinary stucco.

Ambroselli's compo' is laid on in three coats. The sand and lime must be free from all impurities, and the underlying brickwork of good, sound well-burnt bricks, thoroughly set. It must be well soaked with clean water before the composition is put on. This is best done with a hose and force-pump.

The first coat is composed of 1 part of good slaked lime, which should have been slaked at least a fortnight previously, and 2 parts of clean coarse sand. When these are thoroughly intermixed, Portland cement is added in the proportion of 25 per cent. of the whole volume. This coat, which is made less stiff than the other two, is quickly laid on and brought to the required surface. The second coat, laid on in like manner over the first, consists of 2 parts of slaked lime, 2 of fine sand, and 12 per cent. of Portland cement. The third and final coat consists of 1 part each of sifted lime and 1 very fine sand, mixed with ·05 per cent. of cement and a suitable amount of colouring matter if desired. It is very carefully finished off, and the surface is then rubbed down hard with a piece of hard wood or iron. Lastly, the whole is gone over with a polished steel trowel ·005 metre in thickness, which imparts a fine gloss and finish. *Industrie-Blätter, 4th Feb.* 1875, *from Bau-Zeitung.*

Peintures Marmoréennes.—This name is given to a new species of wall-decoration, suggested to the Société d' Encouragement by M. PRUNEAU, a retired notary of Bleneau (Yonne). It has been tried at the chateau of M. d' Harcourt and elsewhere, with excellent results, and has met with the warm approval of the Paris Société Centrale des Architectes.

The *peintures marmoréennes* are double sheets of glass, the inner surface of the under sheet being painted in oil-colour, in imitation of lapis-lazuli, jasper, onyx, or other costly stone. They are used like tiles, for the walls of bath-rooms, the wainscoting of dining-rooms, ornamental pavements, &c. The price varies from 16 to 21 fr. per square metre according to the thickness of the glass. The process is applicable to marqueterie and cabinet-work as well as wall-decoration. *Les Mondes, 4th March,* 1875.

Mica Glaze.—In certain shops at Munich may be seen numerous ornamental articles having the appearance of silver. They are simply plaster casts coated with mica.

The sheets of mica are cleansed and dried, by firing or boiling in hydrochloric acid, and are then reduced to a very fine powder, which is mixed with collodion, and laid on in successive coats, like paint, to any desired thickness.

Articles thus prepared look like silver, are unimpaired by sulphuretted gas or dust, and may be washed with impunity. The collodion adheres firmly to glass, china, metal, and wood as well as plaster, and any desired colour may be given to the mica. A great variety of articles may thus be ornamented at very small cost. *Moniteur Indust. Belge, 1st March,* 1875.

Lacquer for Colouring School-desks.—FERMHALS of Geissen patents the following composition :—

65	parts	of spirits of 95, or 67 of 90 per cent.
8	„	white shellac.
8	„	Paris black or Ultramarine black.
4	„	pounded pumice-stone.
½	„	Paris blue.
4	„	burnt umber (Dutch).
8	„	drier.

The colours and pumice should be well mixed with the spirit before the shellac is added. *Indust.-Blätt. 4th March,* 1875, *from Hessische Gewerbe-Blätter.*

THE PYROPHONE.

THE idea must often have occurred to listeners at chemical lectures, who have seen the common experiment of producing a musical note by holding a glass tube over a lighted jet of hydrogen gas, that an addition might be made to the list of our musical instruments by arranging a set of such tubes so as to obtain a musical scale. Some few attempts have even been made at constructing such a "flame-organ," but, so far as our information goes, none of these have had any success, until some recent investigations by M. Kastner, a young physicist of some reputation in Paris, resulted in the construction of the instrument figured on page 126, and entitled by its inventor the Pyrophone (πῦρ, fire, and φωνή, a sound), from the way in which the sound is produced.

Whether our musicians have gained much in the new instrument may be doubted, but there is no question as to its being a very curious and ingenious application of a scientific principle. The cause of the production of the musical note in the glass tube is well known. An explosive mixture of hydrogen and oxygen is continually being formed and fired, and a series of small explosions produced, the vibrations of which, taken up by the tube, give rise to the notes. That the explosive mixture should be formed, a certain quantity of air must be admitted to the flame, and, probably for this reason, M. Kastner found that when two hydrogen flames, sounding together in a tube, were brought together so as to form a single flame, and consequently expose a smaller total external surface to the air, the sound was stopped. The explanation suggested for this phenomenon by M. Kastner was that there was an interference of the vibrations when the flames were brought together, but it seems more probable that the above explanation is the correct one. The possibility thus afforded of suddenly starting and stopping the note suggested the plan on which the Pyrophone was constructed. A pair of gas tubes, properly fitted with burners at the top, was mounted in a glass tube in the manner shown in fig. 1, so that they could be readily brought together or separated at the ends, and thus a single flame or two separate flames be produced. A number of such tubes was built up into an organ (fig. 1), fitted

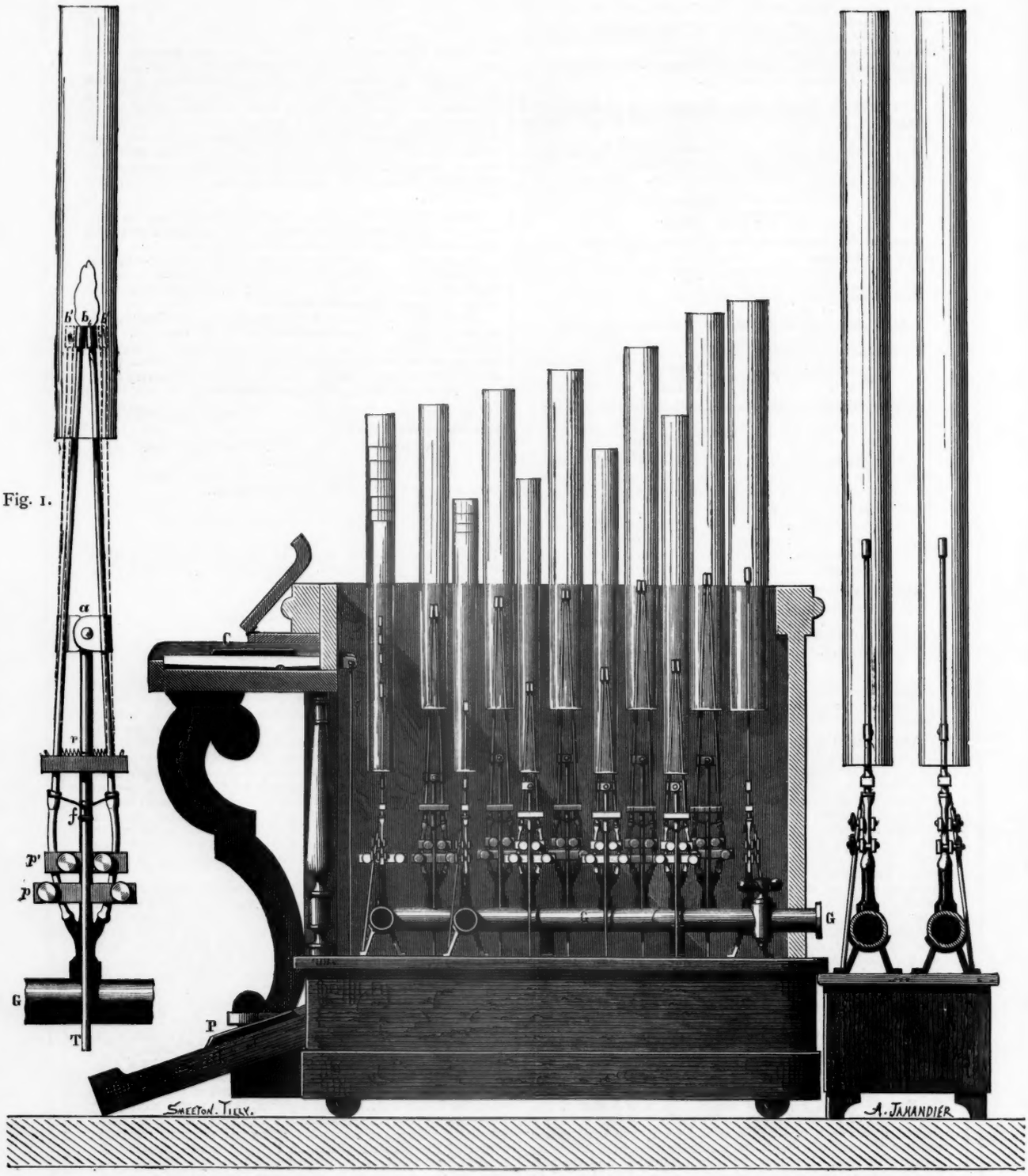


Fig. 1.

THE PYROPHONE.

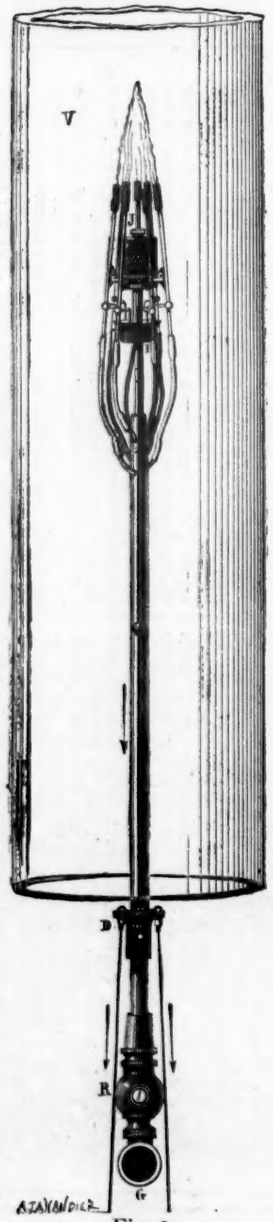


Fig. 2.

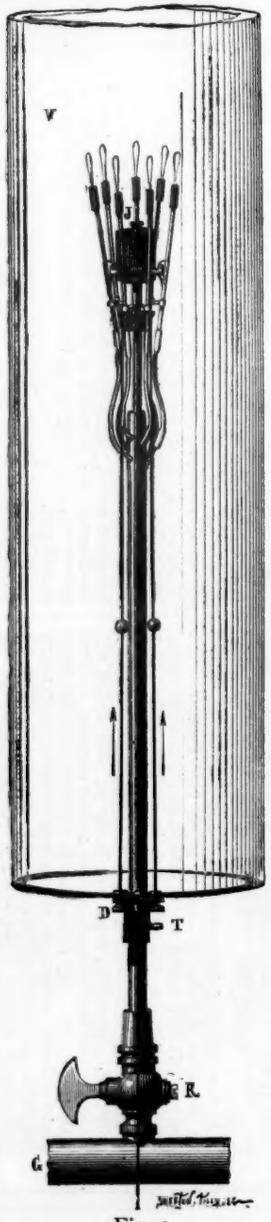


Fig. 3.

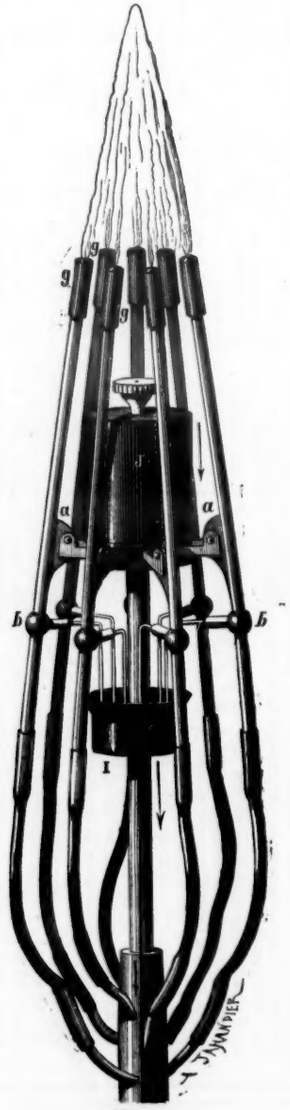


Fig. 4.

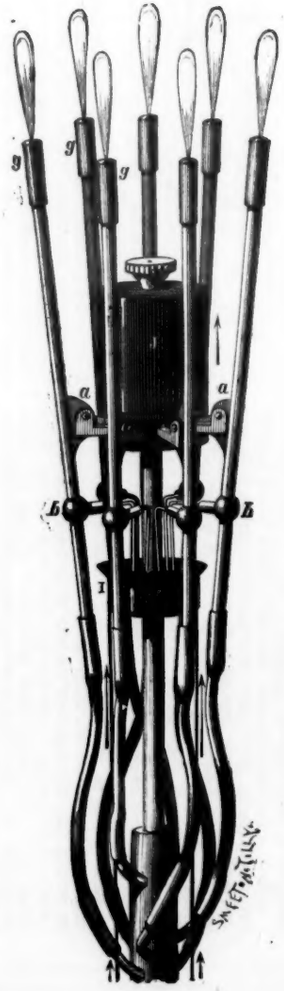


Fig. 5.

with keys and pedals by which the mechanism for altering the condition of the flames was actuated.

A large organ constructed in this way in Paris is said to work very satisfactorily, and to produce sounds of exceeding brilliance and purity. It however requires hydrogen gas, and the inventor was anxious to produce the same results with ordinary illuminating gas. This for some time seemed impossible, until it was discovered that though with one or two jets of coal gas no effect was produced, yet when six or eight small jets were introduced the sounds were produced, while when they were united into one flame the sound as before was stopped. The reason for this would appear to be that with the small flames a considerable amount of surface was offered to the air, so that the carbon was burnt out, and the explosive mixture of hydrogen and atmospheric air formed, as in the first instance; with the one large flame, which of course is much more luminous than the series of small flames, the carbon is not consumed, and therefore the hydrogen is not set free to form the explosive mixture.

To enable the six or eight flames to be joined and separated properly, it was of course requisite to provide some mechanism of a character somewhat more complicated than suffices when there are only two flames.

The accompanying illustrations (Figs. 2, 3, 4, and 5) serve to show in detail the mechanism by which this is effected. Figs. 2 and 3 show the entire arrangement in position within the tube. Figs. 4 and 5 show the mechanical details on a large scale. The letters of reference are the same in all the figures. The wires seen at the bottom of Figs. 2 and 3 are connected to levers set in motion by the keys of the key-board, and serve to give an up and down movement to the sliding piece, D. This, by the wires above it, actuates in a similar manner the socket, I, the upper part of which is bevelled, and surrounds a set of pins connected at their outer ends to the gas-tubes, *b b*, which are hinged at *a* to a ring on the central stem. As this socket rises and falls, it accordingly draws together the pins or allows them to fall outwards, the effect of which is that as the pins are drawn in towards the centre, the lower ends of the tubes are similarly drawn together and the flames separated, as in Figs. 3 and 5. When the ring, I, is lowered, the weight, J, pressing on the ends of the short arms by which the tubes are pivoted to the ring, brings together the upper ends of the tubes, as in Figs. 2 and 4, and unites the flame. The gas-tubes at bottom are connected by flexible tubes of india-rubber to the main supply pipe rising vertically from the pipe, G, which supplies all the tubes of the instrument. R is a tap by which the supply of gas is regulated; T a pin on which the slot in the slide, D, works; N is the glass tube; *g g* are gas burners on the ends of the tubes *b b*. These details are the same in all the tubes, the difference in the note being effected solely by the variation in size and position of the surrounding glass tube.

An instrument of this sort was shown at the Society of Arts on the 17th of February, and a paper read thereon by M. Dunant. It had only a single octave, and was consequently merely a specimen, and could not be fairly regarded as a complete musical instrument. However, making all possible allowance for the incompleteness of the instrument, and for the novelty of its principles, which are hardly yet fully worked out, it must be said that its performances on that occasion were not such as to suggest any reasonable expectation that the Pyrophone will ever become more than what it certainly is, a very interesting philosophical toy. It was obvious that there are difficulties in the way of its being brought into practical use, which can hardly be avoided. Small variations of temperature and of gas pressure seemed to affect the tone very injuriously; the note varied, it got sharper after the first sounding; there seemed considerable difficulty in tuning the instrument, and still greater difficulty in keeping it in tune, and even at its best the tones were not of a character to be compared with those of the organ. So far as the mechanical details went, all worked with perfect smoothness, but there was a very perceptible interval between the striking of the key and the production of the sound. As it is probable that an appreciable amount of time is required for the production of the explosive mixture and its firing, this difficulty would seem to be inherent in the nature of the instrument. Such were certainly the opinions formed by all who inspected the Pyrophone which M. Kastner sent over to the Society of Arts, but it does not therefore follow that the same ingenuity which devised the instrument may not be able to bring it to perfection. We certainly hope that the inventor may succeed, but meantime we must be forgiven our perhaps ungracious expression of opinion that there is less promisé in the instrument than he seems to believe.

THE CHOLERA CONFERENCE AT VIENNA.

THE questions discussed and conclusions arrived at by the Medical International Conference on Asiatic Cholera held some months since at Vienna are the subject of a recent communication to "Les Mondes" by M. FAUVEL, a version of which is subjoined.

1. *Origin of Cholera—Endemicity in India.*—Agreed unanimously that epidemic Asiatic cholera is spontaneously developed in India; that wherever it makes its appearance elsewhere, it has been imported; that it is not endemic anywhere but in India. Although the conference rejects the theory of the European origin of cholera epidemics, it feels constrained to express its fears that cholera may become acclimatized and endemic in certain localities in Europe.

2. *Transmissibility.*—The questions under this head were resolved virtually, and, with one exception, literally, in accordance with the conclusions arrived at by the previous conference at Constantinople. All were carried unanimously, or by a large majority after a very brief discussion. The conference admits that cholera is communicable by persons arriving from infected places; such persons are specific agents only when they arrive at places not previously infected. The disease may be communicated by the personal effects of persons coming from infected places, and particularly by those of cholera patients. Certain facts adduced prove that cholera may be transmitted to considerable distances by personal effects when kept from contact with the air. Having no sufficient evidence before them, the conference declines to express an opinion as to the transmissibility of the disease by articles of food; it is, however, communicable by means of beverages, and notably by water. No conclusive proofs have been adduced to show that the disease has been communicated to man by the lower animals, but it appears reasonable to suppose that such cases are possible.

Unanimously admitting the absence of proof of the transmission of the disease by merchandize, the conference, nevertheless, recognizes the possibility of such a contingency. Although it has not been proved that the corpses of cholera subjects are directly infectious, it is desirable that they should be regarded as sources of danger.

Facts have not as yet proved that cholera is propagated by the atmosphere alone; and it is a well-established fact that in no instance have cholera epidemics spread from point to point except after a lapse of time sufficient to admit of their transmission by human agency. The atmosphere is the principal vehicle of transmission; but in by far the larger majority of cases such action has been limited to very short distances from the centre of infection. The instances cited of atmospheric transmission to distances of one or more miles are not sufficiently conclusive. Facts show that in the open air, the choleraic agency speedily loses its morbific power; but in particular cases of seclusion from the air, this power may be retained for an indeterminate period. Great deserts are an effective barrier against the disease. No example is known of the introduction of cholera in Egypt or Syria, by the caravans crossing the desert from Mecca.

Period of Incubation.—In almost every case, the period of incubation, or in other words, the time elapsing between the moment of contracting the disease and the appearance of either premonitory diarrhœa or confirmed cholera, never exceeds a very few days. All facts adduced in support of a longer incubation are inconclusive, or may be explained away on the supposition that the period of duration of premonitory diarrhœa has been reckoned in the period of incubation, or that the disease may have been contracted after the departure of the patient from the infected place. Observations show that the duration of premonitory diarrhœa—which must not be confounded with the diarrhœa often prevailing in cholera seasons—never exceeds a few days. Certain facts brought forward as exceptions to the rule, do not prove that diarrhœa of longer standing is choleraic or capable of communicating choleraic infection, where the patient has been removed from all sources of contagion.

4. *Disinfection.*—Are any means or processes of disinfection known by which the contagious principle of cholera may surely be destroyed or rendered inert? Ayes, 12; abstentions, 7.

Are any means or processes known by which such results may be sought, with a prospect of success? Ayes, 13; noes, 5.

No specific cholera disinfectant being at present known to science, this conference recognizes the extreme importance of precautions in the shape of ventilation, lavation, cleanliness, &c., combined with the use of disinfectants. Agreed to unanimously.